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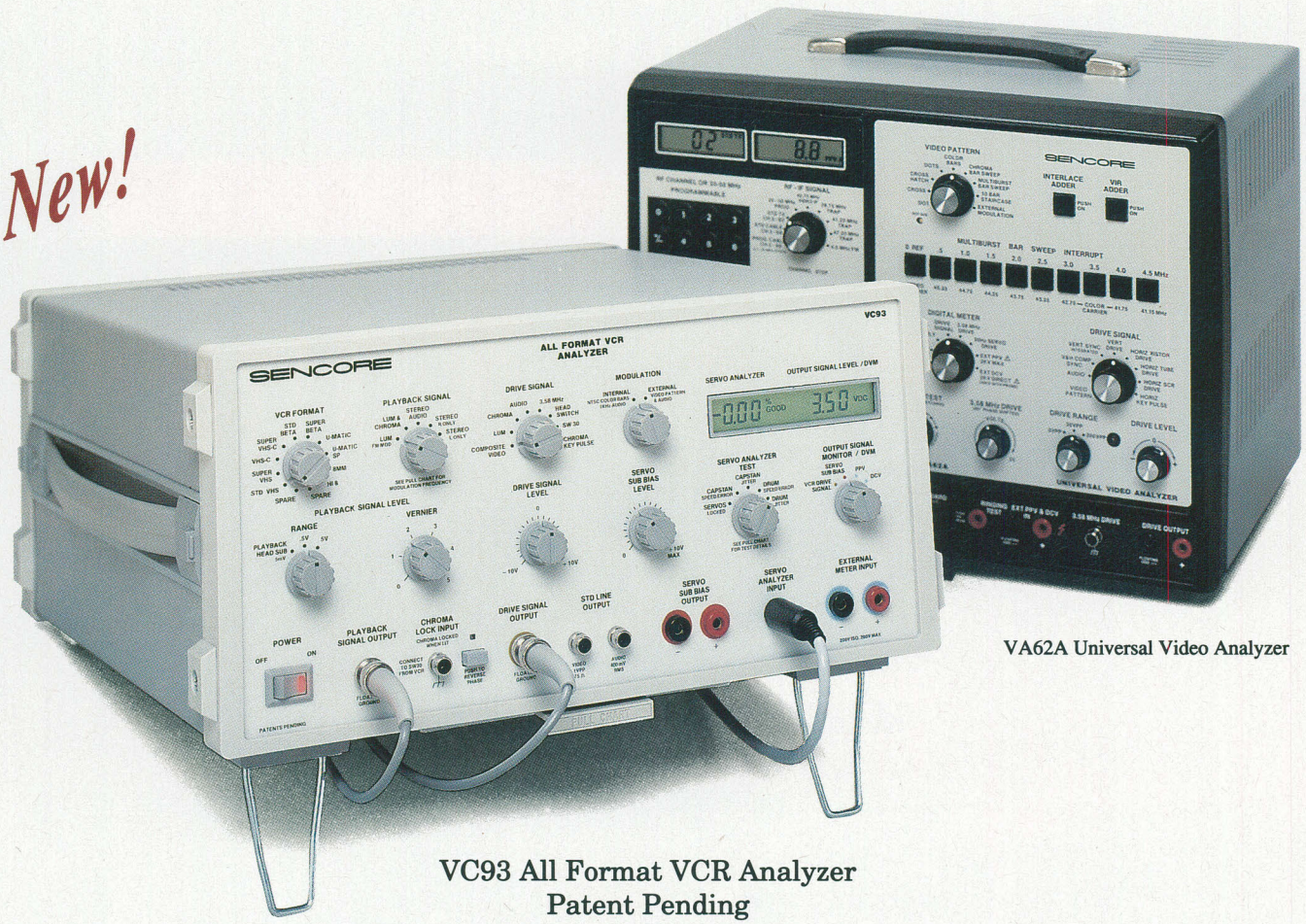

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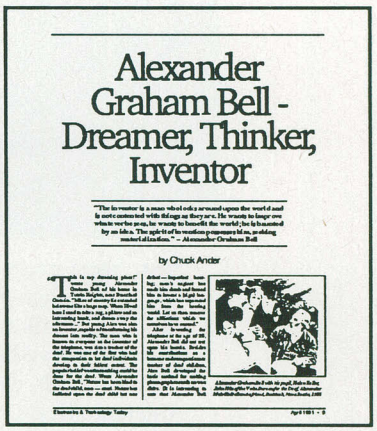
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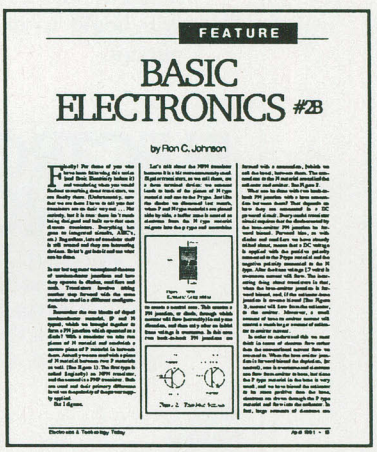
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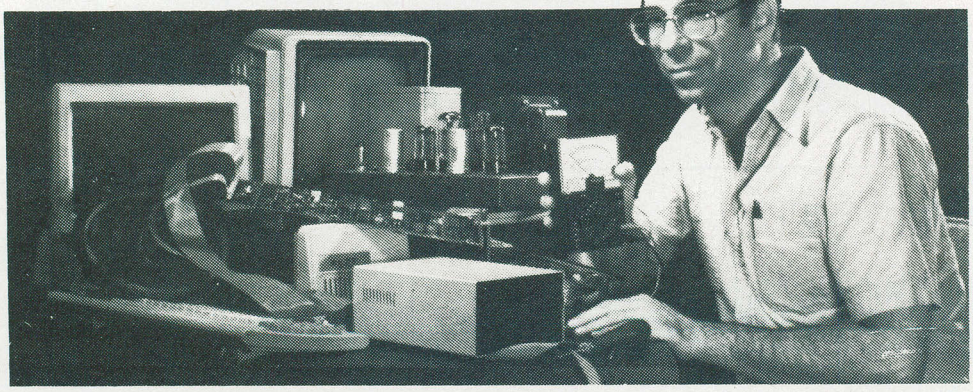

Hi everyone. Well, Spring has taken it's sweet time, but I think it's coming. I, for one, have had enough of winter!

This month, we start a new series on Amateur (Ham) Radio. I hope you enjoy it, and hopefully, perhaps as a result of this new series, some of you will begin to explore this fascinating pursuit.

We're continuing with the **Great Canadian Project Contest** (see the advertisement in this issue). Come one everyone! Get out those soldering irons and spare parts boxes and send in a project. You too can become famous!

So have a great month and enjoy the spring.

Chuck Ander
Editor

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Publisher: ..... V. Kenneth Marskell
Art Director ..... Kevan F. Drinkwalter
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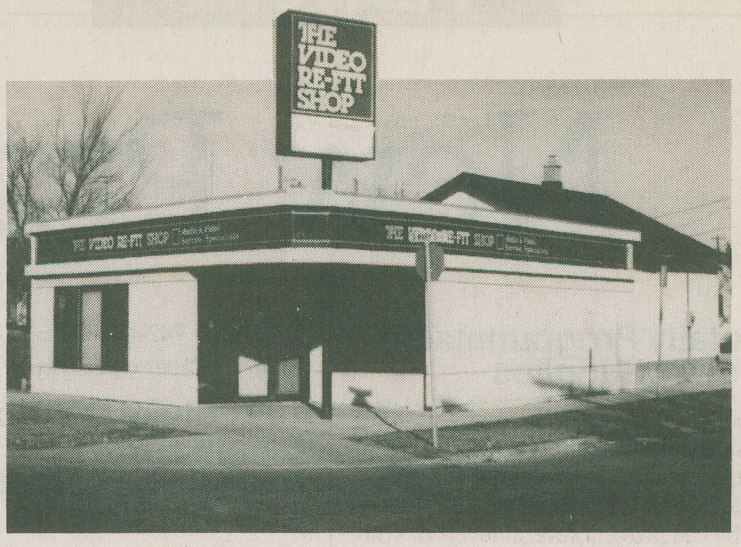

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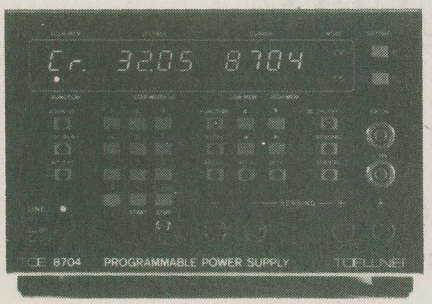

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1991 Fluke Distributor Catalog, Now Available, Features Six New Instruments

The latest edition of the Fluke Distributor Products Catalog, featuring a number of new instruments including timer/counters, frequency counters, an RCL meter and an mAs DMM, is now available. The 20 page catalog also contains photos and information on the Fluke 80 Series, 70 Series and Fluke 45 digital multimeters, as well as on other handheld and bench meters, thermometers and accessories available in Canada through Fluke Electronics Canada Inc.

New to this year's catalog are the Philips PM2618/323 mAs meter for

medical applications, the PM6303 RCL meter, the PM6665 and PM6666 timer-counters and the PM6662 and PM 6669 frequency counters.

The new catalog provides easy-to-use selection guides for meters, counters and thermometers, and an accessory compatibility chart, which allows for a quick check of multimeter/accessory and multimeter/test leads compatibility.

The 1991 Fluke Distributor Products catalog is available at no charge from Fluke Electronics Canada Inc., 400 Britannia Rd., E., Unit #1, Mississauga, Ontario L4Z 1X9 Tel: (416) 890-7600, Fax: (416) 890-6866.
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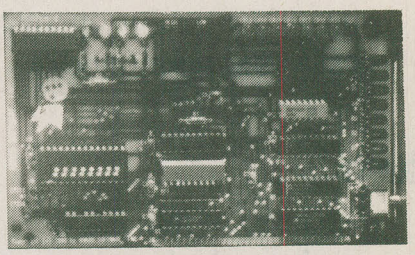

and easy diagnosis of system problems.

The AWARD POSTcard is a plug-in diagnostics board that monitors POST (Power On Self Test) routines and provides continuous built-in testing of pre-boot functions. It supports comprehensive system function and component diagnostics for IBM and compatible PC/XT/AT and 80386 based microcomputers.

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For more information contact: EMJ Data Systems Ltd., P.O. Box 1012, Guelph, Ontario N1H 6N1, Tel: (519) 837-2444, Fax: (519) 836-1914. ❐

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FEATURE

Alexander Graham Bell - Dreamer, Thinker, Inventor

"The inventor is a man who looks around upon the world and is not contented with things as they are. He wants to improve whatever he sees, he wants to benefit the world; he is haunted by an idea. The spirit of invention possesses him, seeking materialization." – Alexander Graham Bell

by Chuck Ander

"This is my dreaming place!" wrote young Alexander Graham Bell of his home in Tutelo Heights, near Brantford Ontario. "Miles of country lie extended below me like a huge map. When I lived here I used to take a rug, a pillow and an interesting book, and dream away the afternoon..." But young Alex was also an inventor, capable of transforming his dreams into reality. The man who is known to everyone as the inventor of the telephone, was also a teacher of the deaf. He was one of the first who had the compassion to let deaf individuals develop to their fullest extent. The popular belief was that nothing could be done for the deaf. Wrote Alexander Graham Bell, "Nature has been kind to the deaf child, man — cruel. Nature has inflicted upon the deaf child but one defect — imperfect hearing; man's neglect has made him dumb and forced him to invent a (sign) language, which has separated him from the hearing world. Let us then remove the afflictions which we ourselves have caused."

After inventing the telephone at the age of 28, Alexander Bell did not rest upon his laurels. Besides his contributions as a humane and compassionate teacher of deaf children, Alex Bell developed the basic method for making phonograph records on

Alexander Graham Bell with his pupil, Helen Keller, John Hitz of the Volta Bureau for the Deaf, Alexander Melville Bell and a friend, Braddeck, Nova Scotia, 1901

Mr. and Mrs. Melville Bell, parents of Alexander Graham Bell, and family at the Bell Homestead, Brantford, Ontario, in the 1870's

wax disks. (It is interesting to note that Alexander Bell improved the phonograph of Thomas Edison, and Edison improved the telephone by inventing the carbon microphone, still in wide use today.) Alexander Bell founded and was active in the Aerial Experiment Association. This group of dedicated aviators built and flew its own aircraft. A very important invention of this Society was the aileron. Previously, the lateral stability of aircraft (or flying machines as they were called) was controlled by "wing warping," a technique developed by the Wright Brothers. Ailerons were far superior to (and much safer than) the previous practice of selectively bending the outer portions of the wings. Other developments pioneered by Alexander Graham Bell include a paper in which he described a device having the same purpose as today's iron lung. He devised an electrical apparatus to locate bullets or other metals in the body. In 1885, he advocated a method of locating icebergs by detecting echoes from them. Years later he concerned himself with condensing fresh water from vapour in the air, for people adrift at sea in an open boat. In the construction of houses he made suggestions to aid air conditioning. For 30 years he directed experiments in breeding sheep, trying to develop ewes that would bear more than one lamb at a time. He developed a hydrofoil that, in 1919, set a world speed record of 71 mph (114 km/hr.) Such a brilliant life had, unhappily, very dark beginnings...

As late as 1920, the dreaded, infectious disease, tuberculosis, was still rampant, often wiping out entire families of twelve or more children. Cemeteries were full of tombstones denoting this pathetic fact.

It was small wonder, then, that terror struck the hearts of Dr. Alexander Melville Bell and his wife, recently arrived in London from Edinburgh, when they learned that their youngest of three sons, Edward Charles, was apparently stricken with the disease. Before they fully realized it, he had slumped into the advanced stages of the disease. Nothing the doctors could suggest helped. Within the year he was dead.

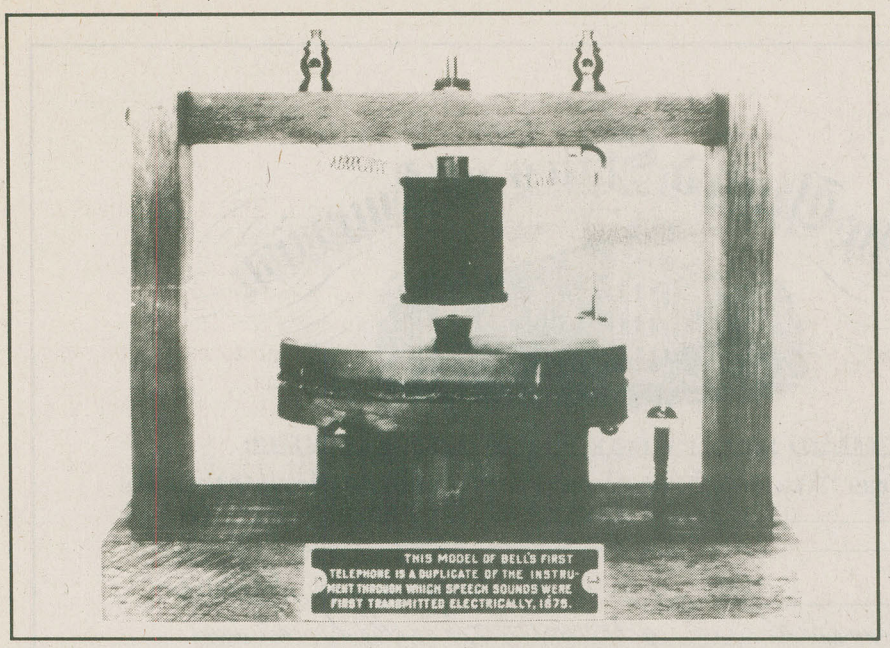
Alexander Graham Bell was at his brother's bedside when he died. He wrote in his diary, "Edward died this morning at ten minutes to four o'clock. He was only eighteen years, eight months old. He literally 'fell asleep'. He died without consciousness and without pain while he was asleep. So may I die."

Tragedy was not finished with the Bell family. Alexander's elder brother, Melville James, caught an extremely persistent cold. It soon developed into a nasty hacking cough. He became pale and feverish. He too, eventually succumbed to his illness. He died in May, 1870 at the age of 25.

As if this wasn't enough, Alexander had become thin and pale and a telltale flush sometimes appeared on his cheeks. The doctor who examined him warned that he was dangerously ill.

The family knew they must delay no longer. To save their one surviving son, Dr. Bell and his wife, Eliza Grace did not hesitate to give up their life in London and move to Canada where the air and climate were more conducive to good health.

While still in London, young Alex had worked along with his father to



Alexander Graham Bell's first telephone was the "Gallows Frame," through which speech sounds were first transmitted electrically on June 3, 1875 in Boston.

develop his ability as an expert on speech. Alex and his brothers constructed a model of a human skull, complete with vocal apparatus that was worked with a bellows. They were able to make their model wail "Mama" in such life-like imitation of a baby that the neighbours turned out to search for the child in distress. At about this time, too, Alex trained his Skye terrier to growl steadily while he manipulated the dog's mouth and vocal cords, trying to shape the growls into words. At the peak of the terrier's career, it was able (with its master's help) to say "Ow ah oo, ga-ma-ma," meaning, "How are you grandmother?" Before long, neighbours were dropping by to see the talking dog!

Alexander's father gave him a book called *Sensations of Tone*, by Hermann von Helmholtz. In this work, Helmholtz reported experiments in combining the notes of electrically driven tuning forks to make synthetic vowel sounds. Alex tried to read the book, which was printed in German, and got the wrong impression that Helmholtz had managed to "telegraph" the vowel sounds, or send them from one point to another over a wire. Although Alex learned of his mistake, he could not get the idea of telegraphing the human voice out of his mind.

Alexander Graham Bell moved to Boston to continue his career as a teacher of the deaf. He was quite successful at it. At the Clarke School for the Deaf in Northampton, he was able in a few weeks to teach the children to use more than 400 English syllables, some of which they had been unable to learn in two or three years under other methods of teaching. One of Alex's most famous pupils was Helen Keller, who came to him as a child, unable to see, hear, or speak. She was later to say of Alexander Graham Bell, "Hearing is the deepest, most humanizing sense man possesses, and lonely ones all over the world have been brought into the pleasant ways of mankind because of Dr. Bell's efforts."

While in Boston, Alex was able to set up a laboratory in the basement of one of his pupil's homes. Bell was not attempting, at this stage, to transmit speech. He was trying to send several telegraph messages over a single wire at the same time. He had been interested, as we have seen, in Helmholtz's work with tuning forks. He knew also that others had transmitted musical tones over a wire by using the "make and break" current of telegraphy. Would it be possible, by using several forks, to send *more* than one tone over the same wire simultaneously, and then separate the tones at the receiving end? Bell thought he could do it, and the apparatus he devised for the purpose he called the "harmonic telegraph."

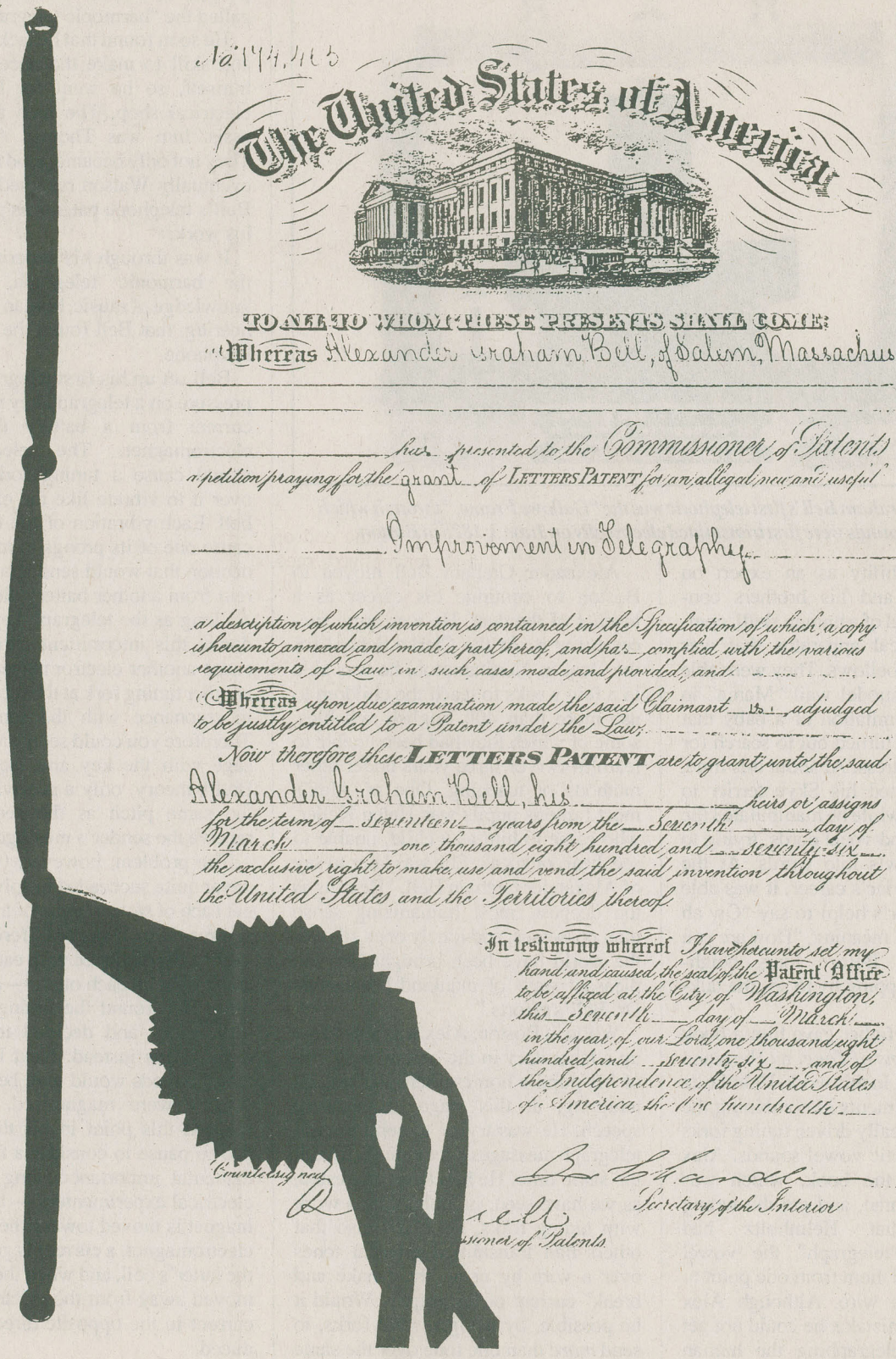
He soon found that he lacked the time and skill to make the necessary parts himself, so he went for help to an electrical shop. The man assigned to assist him was Thomas A. Watson. They not only became good friends, but eventually Watson received a share in Bell's telephone patents as part pay for his work.

It was through his experiments with the harmonic telegraph, plus his knowledge of music, human speech and hearing, that Bell found the way to the telephone.

Bell set up his first telegraph so that pressure on a telegraph key would send current from a battery through an electromagnet. The electromagnet would cause a tuning fork mounted over it to vibrate like the clapper of a bell. Each vibration of the fork would cause one of its prongs to make a connection that would send a pulse of current from another battery along a wire. As long as the telegraph key was held down, this intermittent current would cause another electromagnet to vibrate another tuning fork at the receiving end, in resonance with the sending fork. Therefore you could send a Morse message with the key and, according to Bell's theory, only a receiving fork of the same pitch as the sender could receive the sender's message.

The problem, however, (which Bell never quite succeeded in solving was to get each of *several* pairs of transmitting and receiving forks of different pitch to vibrate in resonance with each other — and only with each other — at the same time. Bell found the tuning forks unsatisfactory and decided to try steel organ reeds instead. Next he decided that the reeds would give better results if they were magnetized. When he reached this point in his thinking, he had to pause to consider a fact of fundamental importance, long known to electrical experimenters — that when a magnet is moved toward the pole of an electromagnet, a current is generated in the latter's coil, and when the magnet is moved away from the electromagnet a current in the opposite direction is induced.

Now Bell's mind leaped beyond the thinking of previous experimenters — for he perceived that his rapidly moving



No. 174,465

The United States of America

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Whereas Alexander Graham Bell, of Salem, Massachusetts

has presented to the Commissioner of Patents a petition praying for the grant of LETTERS PATENT for an alleged new and useful

Improvement in Telegraphy

a description of which invention is contained in the Specification of which a copy is hereunto annexed and made a part hereof, and has complied with the various requirements of Law in such cases made and provided, and

Whereas upon due examination made the said Claimant is adjudged to be justly entitled to a Patent under the Laws.

Now therefore these LETTERS PATENT are to grant unto the said Alexander Graham Bell, his heirs or assigns for the term of Seventeen years from the Seventh day of March one thousand eight hundred and seventy six the exclusive right to make use and vend the said invention throughout the United States and the Territories thereof.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington this Seventh day of March in the year of our Lord one thousand eight hundred and seventy six and of the Independence of the United States of America the One hundredth

Countersigned

Secretary of the Interior

Commissioner of Patents

Patent for the Telephone, awarded to Alexander Graham Bell, March 7, 1876.

Alexander Graham Bell — 1874.

magnetic reed would generate a current that would be alternately stronger and weaker, from instant to instant, as the vibrations of the reed varied. Next he asked himself this: If many reeds of different pitches were vibrating simultaneously over the electromagnet, would they not generate one complex varying current — the resultant of the combined motion of all the reeds?

Bell reasoned correctly that they would. Now, from his experience with music he knew that when you sing into the sound box of a piano when the strings are not damped, several strings will respond. If then, a "harp" transmitter were built with enough strings or reeds, properly tuned, it would pick up every sound of the voice. Therefore, the combined vibrations of the reeds, mounted over an electromagnet, would generate an electrical current which would vary in intensity just as the reeds were vibrated by the varying sound of the voice. And this current would vibrate a receiver harp at the distant end so that the sounds would be repeated.

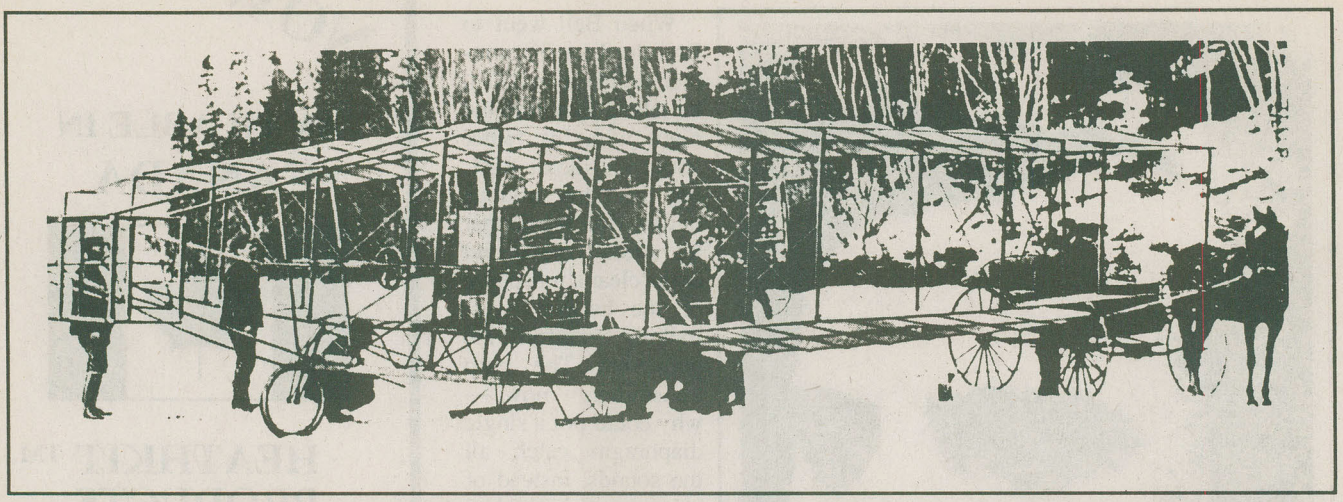
He was on the right track, but this "harp" transmitter seemed too complicated to be practical.

When Bell went to Brantford for his summer holidays in 1874, he talked long into the night with his father about his ideas. Resting from his arduous duties, Bell found that his ideas crystallized in the clear atmosphere of the heights overlooking Brantford. He pondered: The harp transmitter, now, — why could not a single diaphragm catch all the sounds, instead of using individual reeds? The human ear did it, and managed to move the comparatively large bones that have the sensation of hearing. If the end of one magnetized reed were attached to the centre of such a diaphragm, *it would generate a current that would vary in intensity just as the air varies in density when a sound passes through it!*

There he had it. At Brantford, the basic concept of the telephone became complete in Bell's mind: a membrane telephone as a transmitter, a similar instrument as receiver. Melville Bell was keenly interested as his son explained it to him in July of 1874. Joseph Henry, [see *Electronics and Technology Today*, Jan. 1991] secretary of the Smithsonian Institute in Washington, to whom Bell explained it, was also alert to the possibilities inherent in it. Bell doubted that he had the electrical knowledge to reduce his thinking to practice. Henry, then dean of American electrical scientists, said simply, "Get it!" Back in Boston, Bell worked on, and got it.

The First Phone Call

On june 2, 1875, came the "break" in telephone history. Bell and Watson were tuning the reeds of the harmonic telegraph. One of Watson's reeds was screwed down so tightly that it "froze" to the pole of its electromagnet. Watson plucked it to free it. Bell, at the other end of the line heard the twang of a



Alexander Graham Bell's "Silver Dart" on ski-like runners awaiting flight at Baddeck, Nova Scotia, 1909.

plucked reed, a sound with tones and overtones, coming to him over the wire. Quickly he ran to Watson, shouting, "Watson, what did you do then? Don't change anything. Let me see."

It soon became apparent that the reed had acted as a diaphragm and sent an induced, undulating current over the line — a current that varied in intensity precisely as the air was varying in density within hearing distance of that spring.

After an hour or so of plucking reeds and listening to the transmitted sounds, bell gave his assistant instructions for making "the first Bell telephone," and on the next day the primitive instrument transmitted the sound of Bell's voice to Watson.

The two men went on experimenting all summer, and in September, back in Brantford, Bell began to write specifications for his first telephone patent.

For more than 45 years after inventing the telephone, Bell lived a vigorous and creative life, most of it in Washington and at his summer home, Beinn Bhreagh, on Cape Breton Island in Nova Scotia. He gave years of unselfish service in behalf of the deaf. He became tremendously interested in aviation, foresaw its importance, and did much to foster its progresses. He produced other communication devices and carried on constructive studies in eugenics. His mind was ever-inquiring, and his range of interests wide.

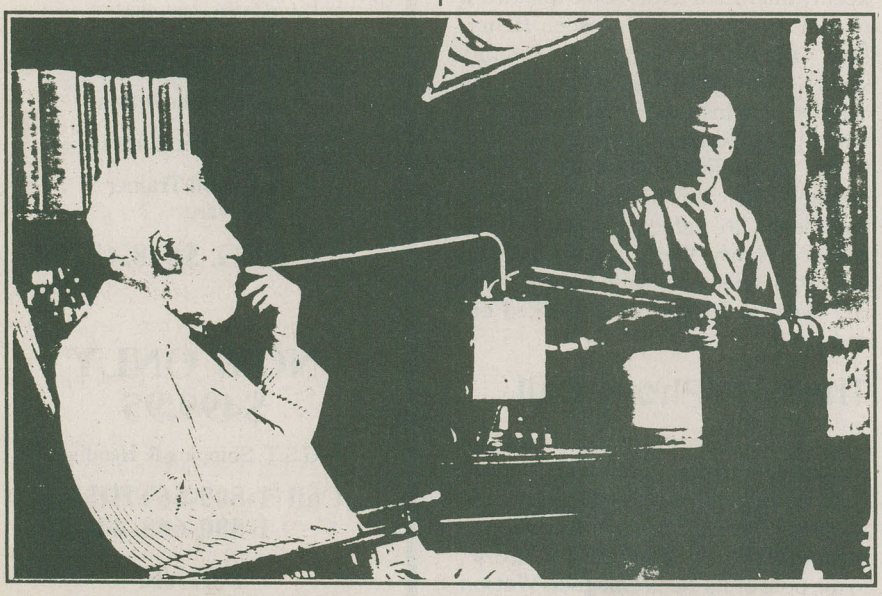
Alexander Graham Bell can truly be called a citizen of the world. Born in Scotland, he worked in Canada and the United States. He died at Beinn Bhreagh, in August, 1922, and was buried on his beloved Cape Breton hillside overlooking the Bras d'Or Lakes.

Enthusiastic and tireless, he was apt in his younger days to wake others in the middle of the night to share with him the excitement and adventure of progress on some experiment. And teachers of the deaf tell of watching Bell communicate to large audiences his own enthusiasm for the teaching methods he advocated.

Bell was impulsive and generous too. Soon after he had invented the telephone, when he had little money, his first public lecture brought him $85. He spent it all on a sliver model of the telephone for his fiancee.

In his thinking, as well as in his works, Bell left much for others. In speaking to a group of children, he encourages all of us as he says:

"Don't keep forever on the public road, going only where others have gone. Leave the beaten track occasionally and dive into the woods. You will be certain to find something you have never seen before. Of course, it will be a little thing, but do not ignore it. Follow it up, explore all around it; one discovery will lead to another, and before you know it you will have something worth thinking about to occupy your mind. All really big discoveries are the results of thought." ❐



Alexander Graham Bell demonstrates a device invented to condense fresh water from vapour in the air, Baddeck, N.S.

Basic Electronics #2B

by Ron C. Johnson

Finally! For those of you who have been following this series (and Basic Electricity before it) and wondering when you would find out something about transistors, we are finally there. (Unfortunately, now that we are there I have to tell you that transistors are on their way out . . . Not entirely, but it is true: there isn't much being designed and built now that uses discrete transistors. Everything has gone to integrated circuits, ASIC's, etc.) Regardless, lots of transistor stuff is still around and they are interesting devices. So let's get into it and see what can be done.

In our last segment we explored the area of semiconductor junctions and how they operate in diodes, rectifiers and such. Transistors involve taking another step forward with the same materials used in a different configuration.

Remember the two blocks of doped semiconductor material, (P and N types), which we brought together to form a PN junction which operated as a diode? With a transistor we take two pieces of N material and sandwich a narrow piece of P material in between them. Actually we can sandwich a piece of N material between two P materials as well. (See Figure 1). The first type is called (logically) an NPN transistor, and the second is a PNP transistor. Both are used and their primary difference involves the polarity of the power supply applied.

But I digress.

Let's talk about the NPN transistor because it is a bit more commonly used. Bipolar transistors, as we call them, are a three terminal device: we connect leads to both of the pieces of N type material and one to the P type. Just like the diodes we discussed last month, when P and N type materials are placed side by side, a buffer zone is created as electrons from the N type material migrate into the p type and recombine

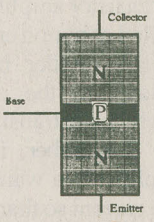


Figure 1. NPN Transistor Composition

to create a neutral area. This creates a PN junction, or diode, through which current will flow (normally) in only one direction, and then only after an initial knee voltage is overcome. In this case two back-to-back PN junctions are formed with a connection, (which we call the base), between them. The connections to the N material are called the collector and emitter. See Figure 2.

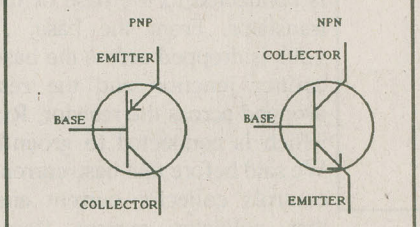


Figure 2. Transistor Symbols

What can be done with two back-to-back PN junction with a base connection between them? That depends on how they are connected in a DC powered circuit. Every useful transistor circuit requires that the diode created by the base-emitter PN junction be forward biased. Forward bias, as with diodes and rectifiers we have already talked about, means that a DC voltage is applied with the positive polarity connected to the P type material and the negative polarity connected to the N type. After the knee voltage (.7 volts) is overcome current will flow. The interesting thing about transistors is that, when the base-emitter junction is forward biased, and, if the collector-base junction is reverse biased (See Figure 3), current will flow from the collector, to the emitter. Moreover, a small amount of base to emitter current will control a much larger amount of collector to emitter current.

In order to understand this we must think in terms of electron flow rather than the conventional current flow we are used to. When the base emitter junction is forward biased the depletion, (or neutral), area is overcome and electrons can flow from emitter to base, but since the P type material in the base is very small, and we have biased the collector to be more positive than the base, electrons are drawn through the P type material and flow into the collector. In fact, large amounts of electrons can

travel through this way, but the quantity is controlled by the much smaller amount that flow out the base lead. So if we vary the base current we can control a much larger level of collector current. This is called amplification or gain.

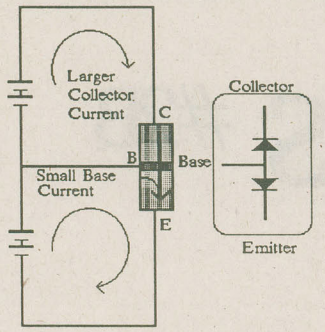


Figure 3. Transistor Bias

By varying the level of the base current we can control the collector current between zero and some maximum value determined by the power supply voltage and the resistance connected between the power supply and the collector. If we have zero current flowing through the transistor we say that it is "cutoff," whereas, if the maximum current is flowing we call it "saturation." These two extremes are used if the transistor is being used as a switch. By applying a small current to the base-emitter junction of the transistor we can switch much larger currents to turn on and off devices such as relays, lamps, LED's, etc. See Figure 4.

If we set the base-emitter current to some nominal value such that the collector current is in the middle of its range (between cutoff and saturation), we are in the "active region" of operation of the device. The circuit can be used as an amplifier because any small change in the base current will be reflected in the larger collector current.

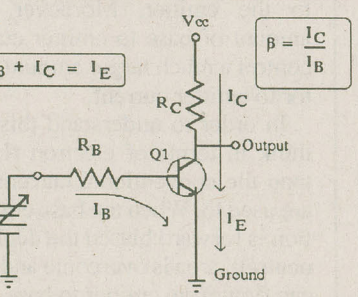


Figure 4. Transistor Current Relationships

The amount of amplification is given in the transistor specifications as ß, beta or h_{FE}.

As you can see, the bipolar junction transistor is versatile. Once you know how the base current controls the collector current and that it can be used for switching or amplification the rest is just a matter of learning how to use variations of the circuit to accomplish your particular application. Because transistors are somewhat temperature sensitive, have differing specs such as beta, maximum current and voltage, etc., the quality of the design is important in obtaining reliable and predictable operation. Transistors circuits are used for many applications from oscillators to amplifiers to digital circuits. Rather than plodding through a each configuration of transistor circuits from a design perspective, let's look at some practical circuits and see how they work.

Figure 5 shows you a typical small signal transistor amplifier. This one is called common emitter with voltage divider bias. That just relates to the configuration in which the transistor is connected. Remember, in a transistor amplifier we want to set up the base current so that the collector current is flowing somewhere near the centre of the range between cutoff and saturation. In this circuit we do that by using a voltage divider. Resistors R_1 and R_2, are connected in series between V_{cc}, (the power supply) and ground. The voltage set at the connection between them, (we'll call it V_B), is connected to the base of the transistor. From the base, .7 volts is dropped across the base emitter junction and the rest dropped across the resistor, R_E, which is connected to ground. We said before that base current controls collector current and that collector current flows down through the transistor from collector to emitter. If so, then both the base current and the collector current combine to flow through R_E. Since we know that the collector current is much greater than the base current the voltage drop across R_E will indicate, for the most part, the collector current. If we have set the emitter to some voltage this will also set the emitter current and thus, the collector current. This is also called the quiescent collector current because that is the DC level it is at without any AC signal on the circuit.

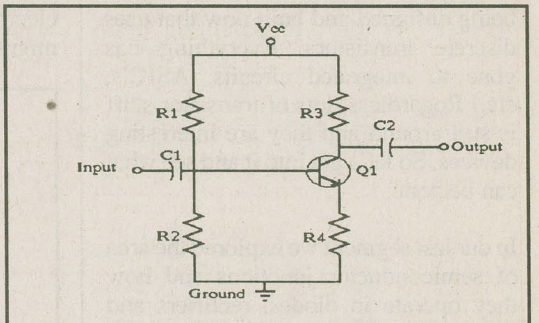


Figure 5. A Small Signal Amplifier

Having set the collector current, let's look at the voltage on the collector. R_C, the resistor between the power supply and the collector drops a voltage across it because of the collector current, I_C but it has no control over what the collector current is. That is controlled by the base current (which we have set in this case using the voltage divider). The voltage (with respect to ground) on the collector will be the power supply voltage, V_{cc}, less the voltage that has been dropped across the collector resistor, R_C. For this circuit the collector is our output point and the voltage there will be proportional to the collector current (but inverted as we will see shortly).

Now we can apply a small AC signal to the base through the capacitor shown, C_1, and this will vary the voltage out at the collector. Note, however, that if the signal applied goes positive, this increases V_b, (which controls the base current), which increases R_E, which increases I_C, which increases *the voltage drop across* R_C, which *decreases* the voltage output on the collector, V_C. All of this means that the output signal will be inverted with respect to the input signal.

This circuit is called a Class A small signal amplifier because it will take a small AC voltage signal (for example, a line out level from a cassette deck) and increase the amplitude of the voltage.

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Class A means that the transistor is conducting all the time that the signal is applied, (360° of input cycle). This one would not be used to amplify the signal to drive a speaker for example because it is primarily designed to provide voltage gain, not current gain as would be required for a power amplifier. The actual gain of the amplifier can be calculated but we won't get into the theory necessary for that here.

Figure 6 shows a simple power amplifier design. This one uses a positive and negative dual power supply so that capacitive coupling is not necessary between the output and the speaker. This improves the low frequency response of the amplifier because the lower the frequency, the higher the impedance of a capacitor. This design also uses two transistors to drive the speaker: one is NPN and the other is PNP. The idea here is to use one transistor to provide current to the load (speaker, or whatever) during the positive excursion of the signal, and the other transistor to do the same on the negative excursion. More efficient than Class A, Class B would have an advantage except that it causes distortion because every time you turn on either transistor you have to overcome the .7 volt knee voltage before you start to amplify. This causes crossover distortion where the signal crosses over the zero point on the AC waveform. To alleviate this problem we operate the amp in Class AB mode, a hybrid of the two where we keep both transistors slightly turned on all the time (.7 volts on the base-emitter junctions) and then apply the signal in such a way that they alternately provide current drive as with Class B. The two diodes shown between the base leads of the transistors, being forward biased by the power supply through a resistor, provide the voltage that keeps the transistors on.

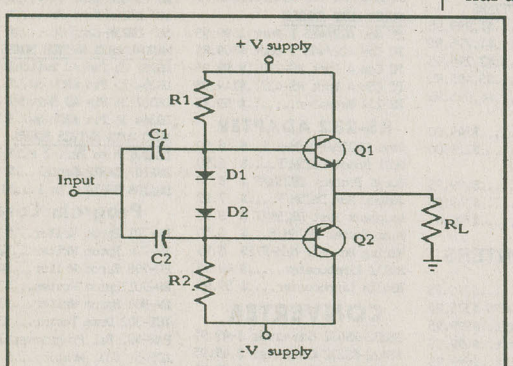

Figure 6. Class AB Power Amplifier

There are several categories of transistor amplifiers: common emitter, common base, common collector, Class A, B, AB, C, and a few others we won't mention. Beyond this there are literally hundreds of variations on these categories. Rather than bore you to tears with a lot of them we'll go on to other transistor applications. In a future segment we'll build a simple amplifier to see how it works.

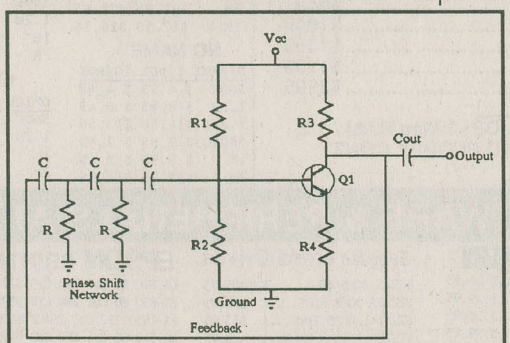

Figure 7. A Phase Shift Oscillator

Meanwhile, let's look at some other circuits with transistors. Oscillators might be a good one. You may already know that an oscillator is a circuit which has an output but no input. Actually, within the circuit itself, the output of an amplifier is fed back to its own input. The circuit generates its own signal as a result of circuit action.

How does it do that? Well, there are actually two criteria which must be met in order for any system (whether it be electronic, mechanical or otherwise) to oscillate. (If you're into it these are called the Barkhausen Criterion.) First, the system must have an overall gain of greater than one. Second, the feedback signal must be returned to the input *in-phase* with the output signal. One way to do that is shown in Figure 7. The circuit is called a phase shift oscillator, and is quite simple to set up or build (although it has some drawbacks as well.) Using the same small signal amplifier we talked about earlier we route the output back to the input through a capacitor/resistor network designed to provide exactly 180° of phase shift.

Remember that a common emitter amplifier inverts the signal when amplifying it. (Inversion is the same as 180° phase shift.) Adding another 180° brings the signal back to 360° or 0°, which is what we need. The approximate frequency of the oscillation can be predicted using the formula $f_r = 1/(2\pi 6RC)$, where both resistors and all three capacitors are the same value. There is also a predictable amount of attenuation in this circuit: B = 1/29. In order to meet the criterion of a gain of one, then, the amplifier must provide a gain of 29 (multiply the amplitude of its input by 29 times).

If the appropriate values for components are chosen this circuit will produce a sine wave at the frequency designed for. One of the drawbacks of the circuit is that it is temperature sensitive and tends to drift, but if you need a "cheap and dirty" oscillator for testing it is quite simple to build. In fact, we might just do that in a future segment...

We have looked at a couple of linear applications using transistors. What about an application using it as a switch? The circuit shown in Figure 8 is just such an application. In digital circuits, where the only two possible outputs of a gate are zero volts or 5 volts (TTL logic), a useful piece of test equipment is a logic probe. Logic probes usually have two leads (to connect to the 5 volt power supply and ground) and a probe tip used to contact various points in the circuit you want to check out. On the body of the probe itself there are two LED's. One indicates a zero voltage (logic level 0) at the probe tip, the other a 5 volt level (logic level 1) at the probe tip. This can be used to track down problems if you know what logic levels should be where.

The circuit shown is a simple one and doesn't have all the features that a professional logic probe would provide but it will do the job for most applications. It also serves to illustrate a couple of transistor concepts which I want to talk about.

First of all, why are there two transistors connected together near the input to the circuit? Remember we said that the base current of a transistor is much lower than the collector current and that the ratio of those two current was expressed as beta, or h_{FE}? If we put two transistors together, one after another, those beta values are multiplied

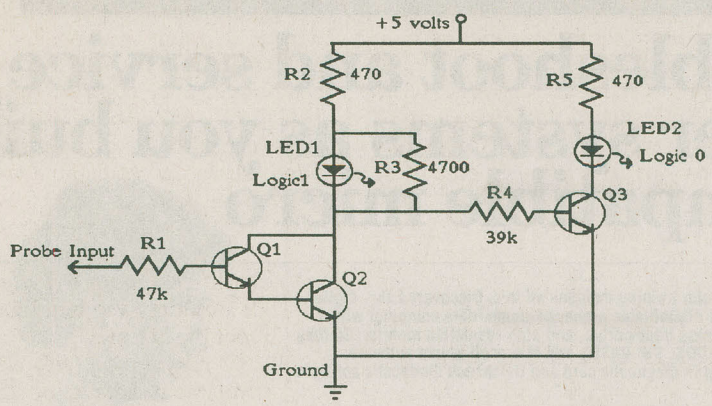

Figure 8. Schematic of a Logic Probe

together. If the beta of the first transistor is about 100 and the beta of the second is the same, the total beta, or current gain is 10,000. That means that very little base current is required at the first transistor for the second transistor to turn on and draw the necessary current through LED1. (That would be a maximum of 20 mA, so 20 mA/10,000 = 2 uA. Not very much.) That is a desirable situation because we do not want the logic probe to "load down" the circuit by drawing a lot of current from it. Another way of describing the benefit of this configuration, which is called a Darlington pair, is that it increases the input impedance of the circuit. (There is a way of calculating the actual input impedance but I'd rather stay away from the math for now.)

Now that we know why there is a Darlington pair in the circuit, how does it work overall? If the input probe is connected to the output of a digital gate, it should be either 0 volts or 5 volts. If it is 0 volts the Darlington pair will not turn on because the basic requirement of a transistor's operation is that the base-emitter junction must be forward biased with requires at least .7 volts across it. (An important fact to remember if you are troubleshooting transistor circuits.) In this case, between the input and circuit ground we have a 47k resistor and the base-emitter junctions of both transistors in series. That will require at least 1.4 volts to turn on the transistors. That means that anytime 1.4 volts or greater is applied to the circuit the Darlington pair will be turned on.

This circuit has been designed so that if the transistor is turned on it will saturate, or the maximum current possible, given the resistance in the collector circuit, will flow. The collector circuit has a 470 ohm resistor in series with an LED in it and is powered by the 5 volt supply of the circuit you are working on. Because the LED probably drops about 1.5 volts across it the total voltage possible across the 470 ohm resistor is about 3.5 volts. This gives about 7.5 mA through the LED. (A little low but there should be enough brightness to see it.) Assuming our estimation of the gain of the Darlington pair was correct we should have a gain of 10,000. Now let's see what happens if the input is connected to 5 volts. That voltage is dropped across the 47k resistor and two base-emitter junctions (5 volts - 1.4 volts = 3.6 volts) if we have 3.6 volts across the 47k resistor there must be about 76 Ua flowing through it. If the current gain is 10,000 then the collector current (current through the LED) should be: 76uA x 10,000 = 760mA. Of course this is ridiculous because we know the maximum that could ever flow through the LED is 7.5 Ma. This indicates to us the transistor is completely turned on, or saturated and the maximum, 7.5 mA is flowing. (By the way, when a transistor is saturated there should be .3 volts or less from collector to emitter— another troubleshooting hint.)

So if the input is 5 volts, LED1 turns on. We said that the collect to emitter voltage of the second transistor in the Darlington would be .3 volts at saturation. Since the emitter is connected to ground, the voltage at the collect is about .3 volts. That voltage is applied to the base of transistor, Q3, through R4. Because .3 volts is not enough to turn on the base emitter junction of Q3, there is no current flowing through the transistor and so LED2 is off. If the input to the circuit is now changed from 5 volts to 0 volts the Darlington pair will turn off. With the second transistor turned off no current is flowing through LED1 so the voltage at the collector rises to 5 volts. (No voltage drops between the supply and collector means there must be 5 volts there. With 5 volts at the collector there is enough voltage to turn on Q3 which switches current through LED2.

Five volts in: LED1 is on. Zero volts in: LED2 is on. There is one other possibility: that there might be a series of pulses applied to the input of the circuit. In this case the LED's would turn on and off alternatively but, depending on the frequency of the pulse waveform, you would probably just see both of the LED's on.

Well, that's about all I can cram into this month's segment. Next month we'll set up some more circuits and take a walk through SCR's, triacs and some other good stuff. ❐

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MARCH 1991

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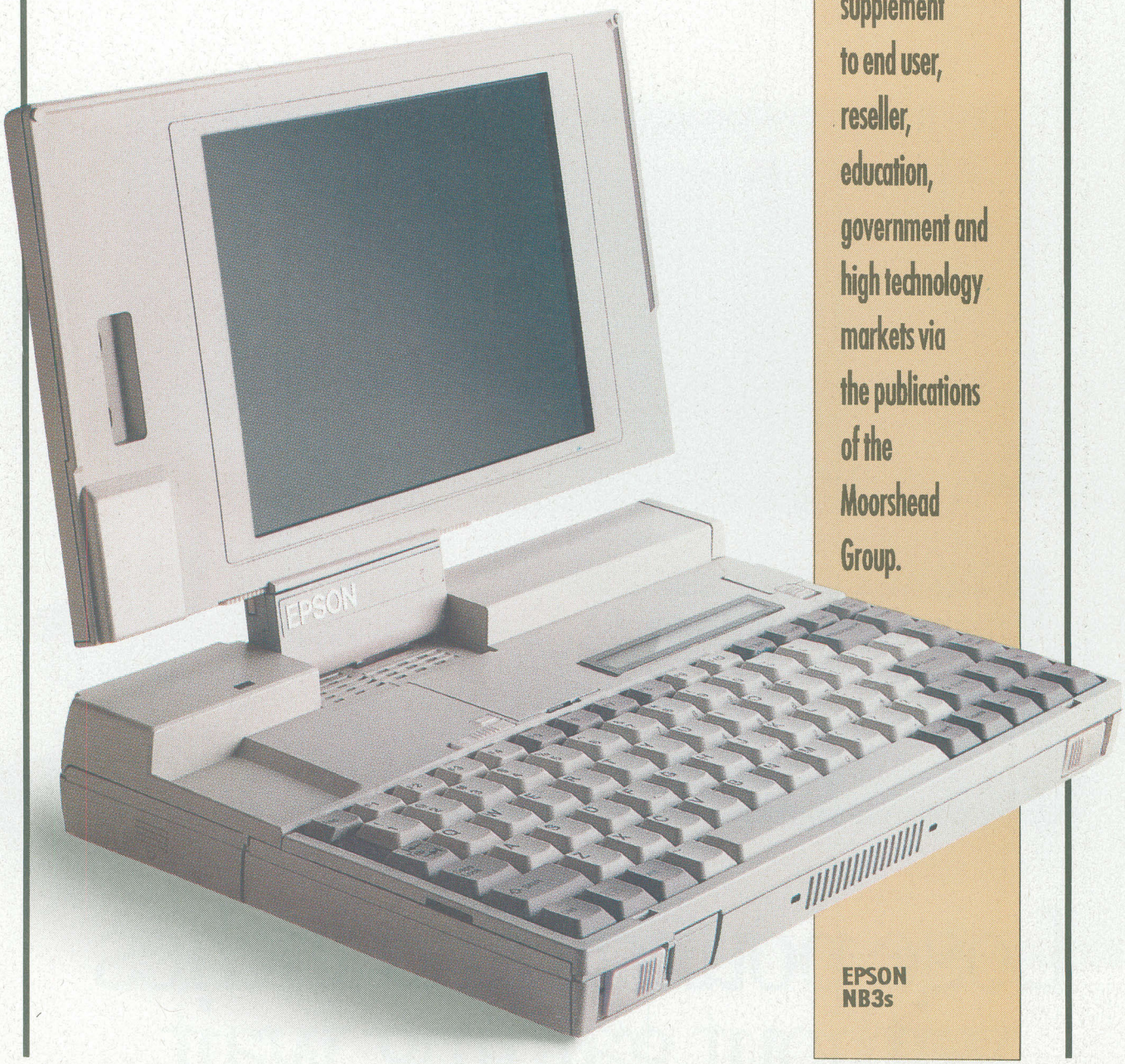

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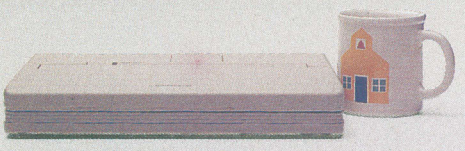

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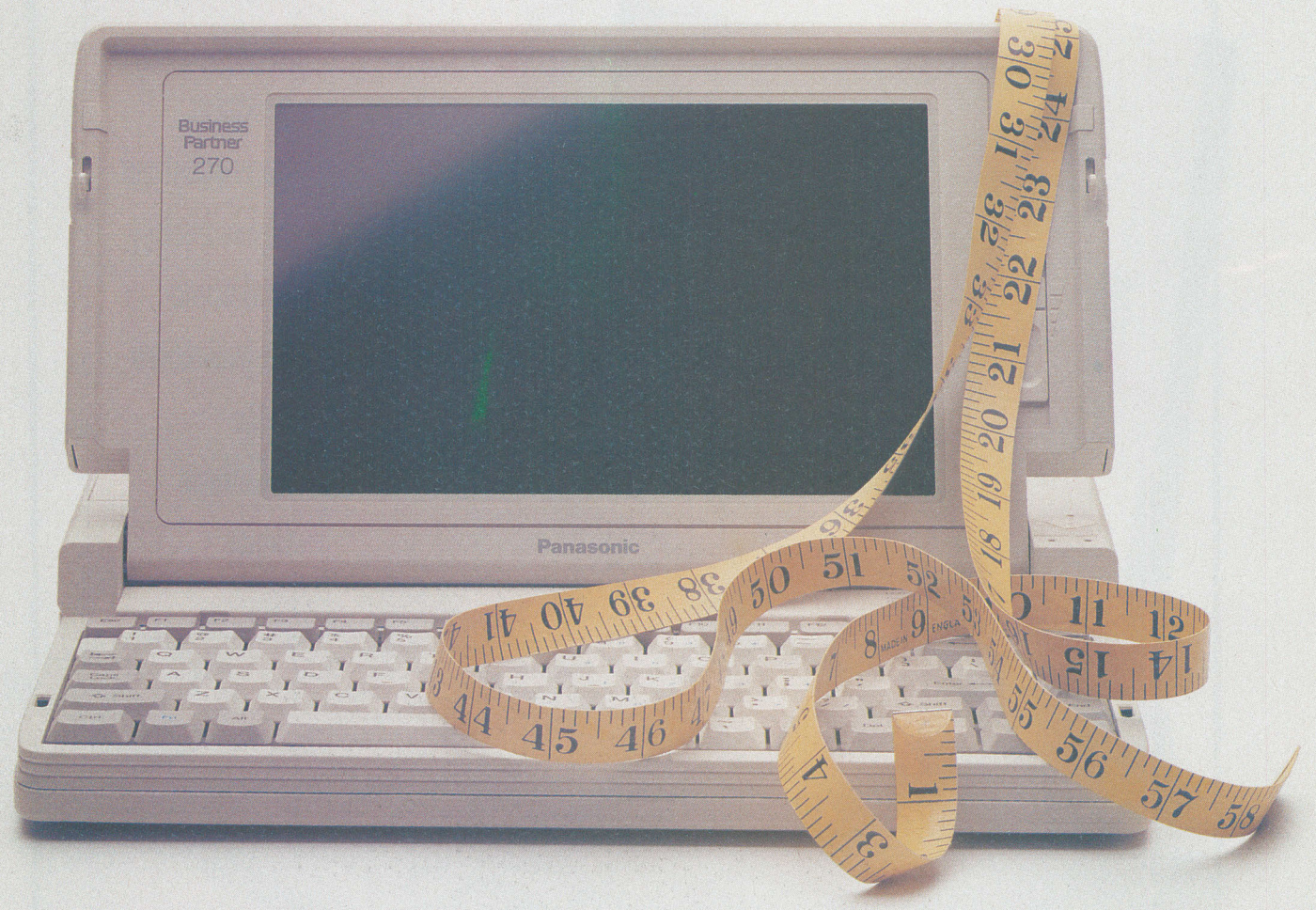

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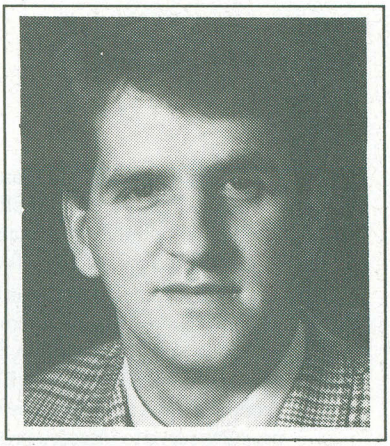


Let's face it. For the majority of computer users business travel is not a significant aspect of their working week. So what's all the fuss about portables, or laptops, or luggables, or any of a number of euphemisms for transportable micros?

The fuss, we can safely assume, stems from the edge of leading technology. In the world of microcomputers we have come to accept that smaller is better; faster is necessary; and convenience is king. Few other segments of the micro market represent such a challenge to the way most of us will conduct our daily lives. True, most of us do not view portability as a necessity *at the moment*, but with continued advancements we could well see a computer in every lap and a battery backup in every coat pocket.

A recent *Evans Report* from Evans Research Corporation reveals that the portable sub-segments of the personal computer market could well account for 14.5-percent of the total Canadian PC market in 1991. Sales of portables, Evans Research also contends, are expected to reach $820 million on unit shipments in Canada alone. And there is no sign of laptop technology coming to a plateau in the near future.

Each month at Moorshead Publications we see as many advancements in portable computer technology as in any segment of the PC market. Within the last six months, 386SX-based laptops have become commonplace. Colour screens are available from many manufacturers. And with Intel's announcement of the 32-bit 80386 SL Microprocessor Superset, battery life in new notebooks could be increased by almost 50-percent by the end of the first quarter of 1991. No doubt in due time we will see features such as built-in CD-ROM drives and fax functions, to name but a few. Stay tuned for details as they become available.

So what better time for an overview of the hottest aspect of the micro scene? Here we have attempted to provide a detailed sketch of what's out there, what's happening, and what the future holds. We even asked several of the leading manufacturers of portables, laptops and notebooks to comment on how they view today's and tomorrow's markets. We can't bring you everything, but we hope sincerely that you find many items of interest in our Special Report on this special part of the PC market.

Andrew Berthoff

Contents

A 1990 Portable Computer Industry Wrap-Up

by Tod R. Rehm, Toshiba of Canada, ISG

4

I consider myself fortunate to be involved in perhaps one of the most exciting of all industries, that being the computer industry, and also to be involved with a world leader in technology – Toshiba.

Clearly, the portable microcomputer industry continues to grow. The slowing economy may in fact act as a catalyst to the microcomputer industry. Strong organizations often increase, not decrease, their high-technology buying during economic slow dons because high technology microcomputer products serve to increase productivity, efficiency and effectiveness. These are factors which should always be a priority regardless of the economic conditions.

The continuing technology trend towards portable computers as desktop PC replacements is also encouraging and signals a new era for our industry. With the arrival of true portable computer colour displays that quite frankly surpass those of even the most sophisticated desktop monitors, the final barrier to complete desktop PC compatibility is effectively breached. Combined with the continuing advances in hard disk technology, which allows lightweight computers to carry upwards of 100Mb and 200Mb of fast internal hard disk storage, the true portable desktop PC/intelligent workstation replacement has arrived.

Mobility will continue to grow in importance in the 1990s. Cellular phones, modems and portable fax machines combined with portable computers allow almost anyone the ability to work away from the office as effectively as they would at their desks. Professionals in all walks of life are reaching for portable productivity tools in ever-expanding numbers, especially as desktop PC replacements and intelligent workstations.

Economics and long-term cost-savings through productivity increases are clearly behind the growing demand for portable computers. Information is too crucial to our jobs to leave behind when we travel. Most important, however, is the tremendous time that portable computers can save, the most precious commodity of all.

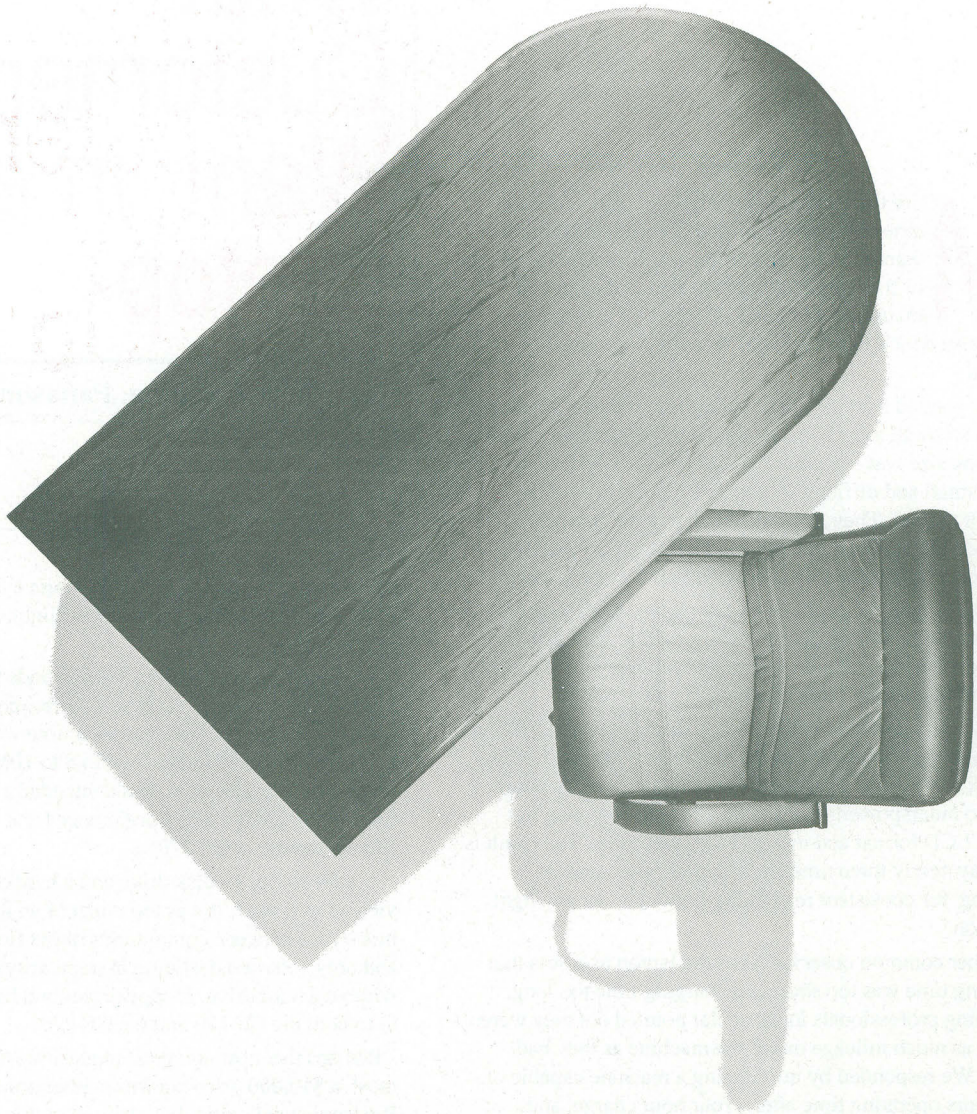
Notebook computers continue to lead the Canadian marketplace in terms of innovation. The recently-announced Toshiba T2000SX and T1000LE are two more examples of the increasing innovation being poured into notebook computers. Canadian notebook growth in 1991 is expected to be approximately 50-percent, while laptops and portables will continue to grow at a healthy 45-percent. This is in stark contrast to the desktop PC and other computer markets.

With the continuing miniaturization and integration of this incredible technology, however, and the increasingly small and powerful computers of the future come the added risk of theft and data security. Professionals in the law enforcement, health, accounting and financial industries are particularly concerned about data security. A key feature for microcomputer manufacturers is to address successfully this concern and to design effective, transparent data security solutions. The recently-announced Toshiba SmartDrive, which combines a tiny integrated circuit (smart card) reader with a conventional floppy disk drive, we believe effectively addresses this issue.

In the near future the evolving capabilities of the portable computer will feature a phenomenal keyboard with exceptional crispness and response, a wonderful colour display, batteries that seem to never die, dozens of megabytes of memory and disk capacity, and total communications ability, all packaged in am 8.5 x 11-inch design that weighs only a few pounds. Through its never-ending commitment to research and development, Toshiba ISG is well on the way to developing such a product – just ask any of our thousands of satisfied Canadian customers.

Tod R. Rehm is Group Vice-President and General Manager of Toshiba of Canada, ISG, of Markham, Ontario.

Toshiba conquers a new space



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What Customers Want in a Laptop

by Chris Canning, Panasonic Canada

More than a year ago Panasonic conducted an extensive survey to find out what customers wanted in laptop computers. Based on the results of that survey, we proceeded to design and manufacture the CF-170 and CF-270 – two notebooks which Panasonic has recently introduced to Canada.

Users wanted a laptop small enough to fit into a briefcase, yet not so small as to impede use. Anything smaller than a notebook size was not practical because the keyboard would be too small and difficult to use. The display would be difficult to read. They also asked for a lighter machine. We responded by making our laptops 25-percent smaller and 15-percent lighter than what was available a year earlier.

Not surprisingly our notebook computers, weighing only 6 pounds with both hard disk and floppy drive included, have become a target at which other manufacturers aim. The fully compatible computer in a briefcase is now a reality.

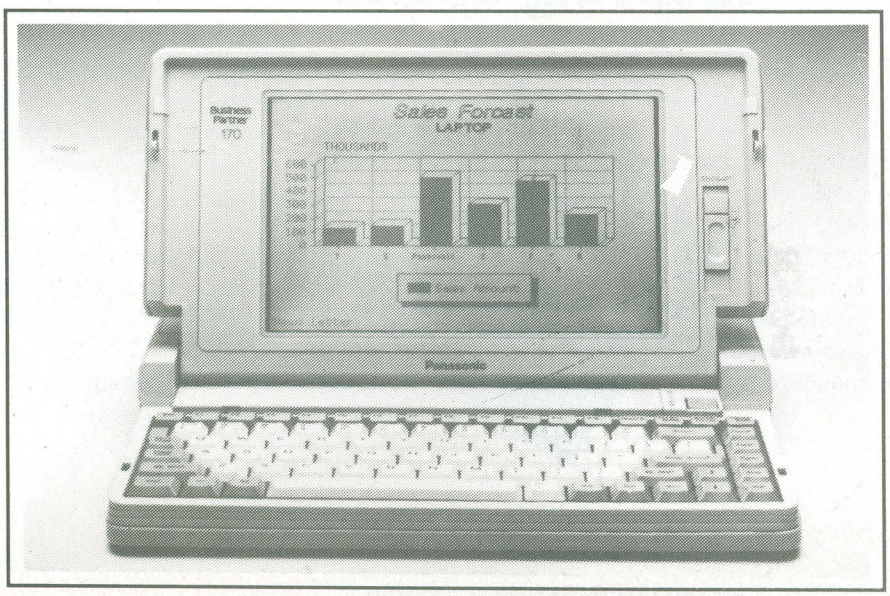
Many users pointed out that laptop displays were difficult to read. Although we considered a gas plasma display for our laptops, we decided against this option because gas plasma uses too much power. Instead, we chose to stay with the backlit LCD format and increase the brightness. The result is a display nearly three times as bright as other models, allowing for consistent readability under almost any light condition.

Another common observation of the laptop user was that operating time was too short and charging time too long. Travelling professionals in particular pointed out they weren't getting as much mileage out of the machine as they had hoped. We responded by introducing a machine capable of four hours operating time after a four hour charge, and another machine capable of running three hours with only a two hour charge. In what we feel amounts to an industry breakthrough, it is now possible to use a computer for extended periods, like an overseas flight, when no AC power is available.

We found that the customers' demands for better processing capabilities depended on what their primary use of the laptop was. Users spending most of their time wordprocessing felt that an 8088-based machine with 8 to 10MHz operating speed was sufficient. Heavier users demanded a 286 machine with a minimum 12MHz, and a preference for a 16MHz machine like Panasonic's CF- 270.

A built-in floppy disk drive and a hard drive were also viewed as a *must*. It was too much of an inconvenience to move files between computers without floppy disk medium, and only software declining in popularity could be run without a hard drive. Floppy drives and hard drives were built in to both the CF-170 and the CF-270.

Perhaps the most universal request was for affordability. For most, a $10,000 price tag was neither practical nor realistic. Panasonic paid particular attention to this request, recognizing that a lower price was and continues to be the key to widespread acceptance of laptops, just as it was for desktops in the '80s.



If one looks at the customer buying criteria – size, display, battery life, processing power and price – it is evident that significant progress has been made during the past year. There has been a breakthrough in performance and price. For Panasonic or any other manufacturer of laptops there is no real mystery to what constitutes a breakthrough. It is just a matter of listening to what the customer wants, and then striving to give it to them.

Chris Canning is Manager of the Computer Equipment Department at Matsushita Electric of Canada (Panasonic) Ltd.

The Industry: What To Expect

by Gordon S. Wood, Bondwell Canada

As more manufacturers get into the production of laptops, the face of the market is changing. In the beginning, laptops were sold to the corporation mostly with the help of MIS departments. This was necessary because laptops were complicated and technical units, primarily with vertical applications in accounting.

With the increase in competition laptops have become packaged goods. This was out of a necessity to decrease overhead of value adding. Most units on the shelf come like a ghetto blaster rather than a stereo system. This opens a whole new market to the laptop manufacturers. Now, anyone can purchase a unit at 9:00am and have it fully operational by 9:10am in their car, if need be. The products offered today come fully configured with hard drives, screens, memory, keyboards and all the ports anyone would wish for.

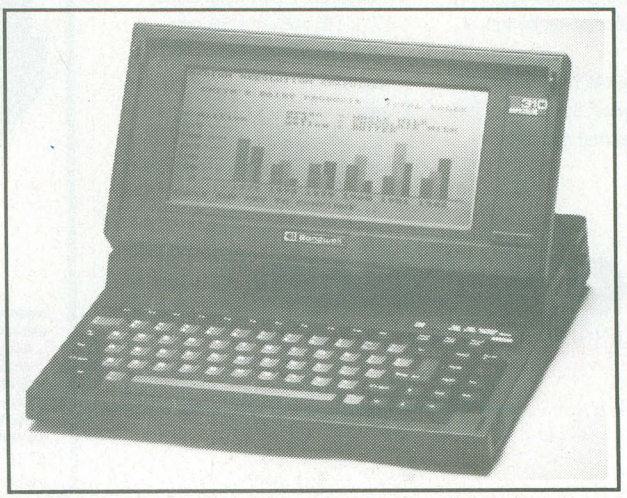
One of Bondwell's 268-based laptops nets out cheaper than some desktop 286s when fully configured. Add to this the portability and the small footprint and you get many features and benefits in favour of laptops. The home office is our largest and fastest growing market. As baby boomers find that there is great deal of competition for top spots at corporations, they are finding more innovative ways to generate income as well as to use their time. Some executives are using golden parachutes to open franchises, start backyard businesses, and become entrepreneurs.

All of this creates opportunities for the computer business. Laptops come closest to fulfilling the needs of this group, since very little knowledge or expertise is required, other than being able to open the box.

Another factor is affecting the laptop market. Mass marketers such as Sears and Woolco are entering the ring. Companies like Zellers and The Bay are considering opening their stores to computers. For the mass merchants, desktop units may prove to be too unruly to handle through this venue. Not only do they require a high degree of selling time on the floor, but the vast amount of SKUs required just to offer even the most basic of units makes them a nightmare for most buyers. As well, mass marketers have to compete with the garage manufactured units that have plagued all legitimate retailers for years. On the other hand, a laptop comes into this venue as one SKU. It requires very little selling time on the floor, and advertises cleanly. Laptops have the edge over desktops in the competitive end of things. Since a laptop is difficult to engineer and manufacture, the garage builder will not be an issue in the pricing strategy of laptop manufacturers or retailers.

With increased competition at the manufacturing and retail levels, prices of laptops are decreasing, thus making the laptop available to users on tight budgets, such as students. All of this makes the specific direction of the laptop market difficult to pinpoint. One thing is certain though, the laptop market will grow at a phenomenal rate over the next few years, regardless of the economy.

Gordon S. Wood is National Sales/Marketing Manager for Bondwell Canada Ltd. in Toronto, Ontario.



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Laptops: What Are You REALLY Buying?

By Joe Reid, Hyundai Electronics

A laptop by any other name is often the same laptop.

Following a steady increase in popularity in the c omputer marketplace, laptops have quickly become commodity items. Essentially, the laptop manufacturing process involves several layers of O EMs. Beginning with a handful of chip manufacturers, the process of manufacturing laptops sees these manufacturers supplying chips to the OEMs manufacturing boxes, hard drives, and so forth.

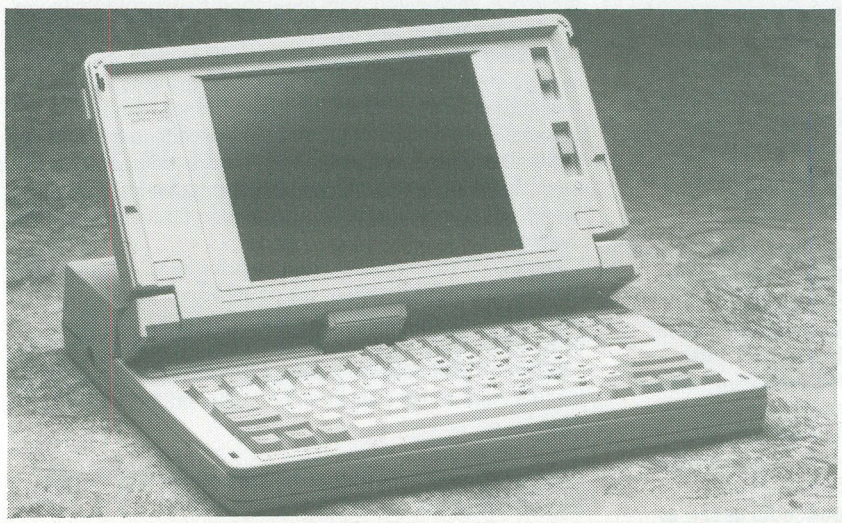
The laptop market has followed the precedence set by the PC market, where most name brand products are an assembly of parts, configured to the specifications of the vendor from whom you choose to buy.

Since the key components within all laptops are identical, what should go into the laptop selection process? The answer lies in comparing screens, storage, power, batteries, expansion options, as well as size and weight, in order to find the combination that best meets your requirements.

Screens. Once the major downfall of laptops, screens have now progressed from CGA to VGA. VGA provides clear images by means of multiple grey scales. In addition, there is the option of gas plasma displays, which are easier to read than liquid crystal displays (LCD), although they are more expensive and use more power.

Mass storage. Today's laptops typically come with at least a 40Mb hard drive. Choices even extend as high as 60Mb or 120Mb in some cases. The floppy disk drives are generally 1.44Mb 3.5-inch high-density units.

Power. You may want to consider a portable with a power saving option such as a standby mode. The benefit of this option is that it minimizes the drain on the battery while your machine is not in use. Another power-saving option is automatic resume, which saves your session and turns the machine off. Upon your return, you can have the program up and running almost immediately, instead of having to reboot.



Batteries. Most portables have quick-change batteries, but there are differences in recharge times that should be considered. Some batteries can recharge in two to three hours, while others must be charged overnight. You might want to look at a vendor who offers external chargers so that you can keep spare batteries charged at all times. For international travellers, double check to make sure the laptop you're buying runs on 110 and 220 volts, (most do). Some even offer 12-volt adapters for car or boat use.

Expansion units. These are an optional add-on for the portable market, otherwise called docking stations. They are most useful in cases where a user needs to be able to tie into a larger computing system on occasion. For example, if a businessman frequently travels with his laptop but needs access to his company's computing resources, an expansion unit may prove invaluable.

Size and weight. In general, size and weight are being trimmed on an ongoing basis. While you might choose a laptop for its portability, you shouldn't choose one laptop over another for the sake of a few ounces or an inch.

There are two other things to consider. Be sure you're comparing identical features when choosing a laptop. Things like software and batteries will affect the price, so if you're getting a price break, be sure you're still getting the hardware and features you need. Also, when you're choosing a vendor, choose a company with longevity. While laptops may be a commodity item, repairs aren't. Select a vendor who can support the product, or offers third party maintenance services, and make sure the vendor of choice is committed to the computer industry for the long term.

Joe Reid is vice president of sales and marketing for Hyundai Electronics.

Portable Computers Now Offering 'Bleeding Edge' Features

By Stephen Parry, Hitachi (Canadian) Ltd.

According to Evans Research Corporation (ERC), portable computer sales accounted for over 14-percent of the total PC market in 1989, and by the end of 1991 this sub-segmented market will account for over $596 million in revenues.

A large portion of these revenues is being derived from the laptop segment of the portable market, or machines weighing more than eight pounds and fewer than fifteen pounds. ERC points out in its 1990 report, "Canadian Portable PC Market," that although almost 45,000 laptops were shipped in 1989, there was a dramatic shift in customer requirements.

High powered machines featuring 80386 and 80386SX processors captured almost 40-percent of shipments and that figure should grow to 50-percent in 1991. The inevitable leads to the question: Are just the excellent processing and throughput features of laptops spawning a boom in this sector? After all, laptops have been around since 1982, yet it has been only in the last two years that these innovative machines have been swaying the PC crowd to on-the-go computing.

The answer to the question is a simple no. Processing capabilities alone have not revolutionized the laptop market. However, the 386 processors have contributed by allowing users to run popular software packages, improved display resolution on larger screens, as well as higher capacity hard drives, are making the laptop appealing to more and more users. These hardware advances, coupled with user needs to have access to programs and databases at virtually any place and time, are making laptops more desirable than stationary PCs.

Super-Twisted Nematic (STN) technology had traditionally been the screen technology of choice for laptops until recently when Thin Film Transistor (TFT) technology was introduced. TFT has combined with side or back lighting – which is now the standard on most laptops – and high resolutions of 640 x 480 pixels to fulfill the key user requirements of the '90s when it comes to laptop display technology.

To date, only three manufacturers have introduced TFT-based colour portables with full VGA capabilities, and a number of other vendors are evaluating the technology. The VGA colour displays are easily implemented with 80386/80386SX-based portables at the high end, while EGA is still popular on 8086/80286-based machines. ERC reports that marketshare in 1991 will be minimal for colour portable displays, however the research firm foresees a swift ramp-up in demand to 50-percent of the overall portable market by 1995, as manufacturing efficiencies increase and the technology matures.

This is an important statistic for the many companies targeting the so-called colour market. In fact, it verifies that the market is gradually shifting towards colour laptop displays, preferably TFT-based, for customer requirement in commercial, education, government and business sectors.

The marketing and sales departments of these organizations have been the first users to adopt the new colour technology, which will probably expand to all general purpose laptop users. For instance, field sales forces in the insurance business are taking advantage of colour displays to demonstrate products and perform in-depth presentations. With as few as eight primary colours (future systems will offer up to 512 colour variations in the next couple of years), professionally-presented charts and graphs can be used to depict actual product offerings and scenarios.

It is a well-known fact that companies will spend money to make more money. Often that entails equipping sales personnel with the most efficient tools to do their jobs effectively and professionally.

Similar to other sectors of the computing industry, the portable market of the next few years will be one focussing on open systems. Industry standards will be a must for vendors seeking in a predominantly DOS world, with limited viability for Unix of OS/2. The real strengths for this market will be hardware flexibility, TFT active matrix LCDs, fast processing and mass storage availability. In fact, storage has now become a commodity item with 100 megabyte hard drives soon to be the norm due to user needs for larger, more sophisticated programs and decreases in hard drive manufacturing costs.

Laptops equipped with TFT-based colour LCDs incorporating docking station or the portable power station concept will replace the desktop computer by 1996. Laptop users will be able to plug into a PC base station at home or in the office, and benefit from the station's connectivity to the host mainframe or LANs, while still maintaining portability.

The docking of the power station will provide ample storage, perhaps a 200 or 500 megabyte drive, tape backup unit and possibly a CD-ROM drive. The station would automatically recharge laptop batteries while in the docking mode. Instant accessibility to the network, without the need to reconfigure the laptop, as well as information interchange between laptop and station are two important benefits of this concept.

There are a number of exciting possibilities for the portable market, as concepts such as the portable power station continue to squeeze out stationary PCs and narrow the computing field to host mainframes and portables/PCs. It is certain now that portable technology will not just be on the leading edge of this transition, but rather on the 'bleeding edge.'

Stephen Parry is Sales Manager, Office Automation Division, Hitachi (Canadian) Ltd., in Mississauga, Ontario.

NEC: An Innovator in the Laptop Market

by Stan Ossias, NEC Canada, Inc.

An increasingly segmented market and a growing demand for the modular portable are trends NEC addresses in its long-term vision of the laptop computer market.

"The auditor places more importance on power over portability, while the mobile executive values portability over power," said Tom Ward, marketing manager with NEC Canada, Inc.

Ward was speaking at a seminar on laptops at the Canadian Computer Show November 14, 1990.

"It's obvious that one laptop does not meet the needs of all users," he said. "As a result, the laptop market is becoming more and more segmented."

NEC anticipated this market direction long before it began to manifest itself and developed a range of laptop products to fit a variety of applications accordingly.

Ward said it's all part of the manufacturer's emphasis on thinking ahead.

NEC occupies a secure spot in the global marketplace. It ranks among the four largest computer companies in the world, and Ward said it can't wait for others to take the lead.

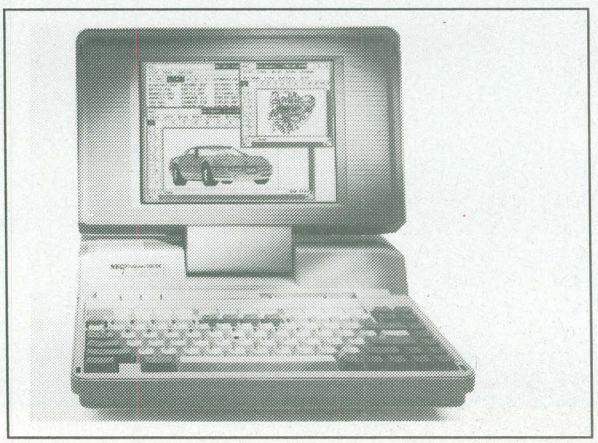
"We at NEC believe that a leader must have a clear, long-term vision and set the pace with innovative new products.

"We're committed to anticipating change, as we did when we introduced the first notebook computer – the UltraLite – just over two years ago. We knew then that the future of laptop computing was going to be about mobility and power."

In foreseeing the kind of segmented market we are beginning to see today, NEC introduced a full laptop product line to meet the needs of each segment.

"For power users such as the analyst, auditor and consultant, the ideal type of portable in the modular 386 laptop – NEC's ProSpeed 386 and ProSpeed SX/20," Ward said.

For sales automation, insurance, field service and general office use, traditional laptops like NEC's ProSpeed 286 offer a balance between power and portability. For highly mobile users such as executives, Ward said notebook computers like the UltraLite and UltraLite 286V are highly portable solutions.



"Currently," Ward said, "notebooks are in the early adopter phase, while traditional laptops, having been around longer and gained wider acceptance, are in the early majority phase." The early majority phase means that people no longer look at these laptops as extraordinary items, but as ordinary business tools.

Ward said that NEC research indicates traditional laptops are on a collision course with the data communication capabilities of desktop computers.

"More and more portable PCs are out there doing critical things like sales automation, customer support and field engineering, and are even serving as users' primary PCs."

Because information sharing will offer a competitive advantage to companies in the '90s, when faster response to markets and better customer service will be key, these laptops must be able to communicate effectively with other computers. "They must be able to tie in to local area networks, laser printers, high resolution monitors and other vital peripherals, yet maintain battery-powered portability," Ward said.

"If they don't communicate effectively, collision is the result."

In anticipation of this need for laptops which double as desktops, NEC pioneered the workstation concept with the ProSpeed 386 and second generation ProSpeed SX/20.

"The modular PC concept involves a docking station that remains fixed in the office, where it's connected to peripheral and local area networks," Ward said.

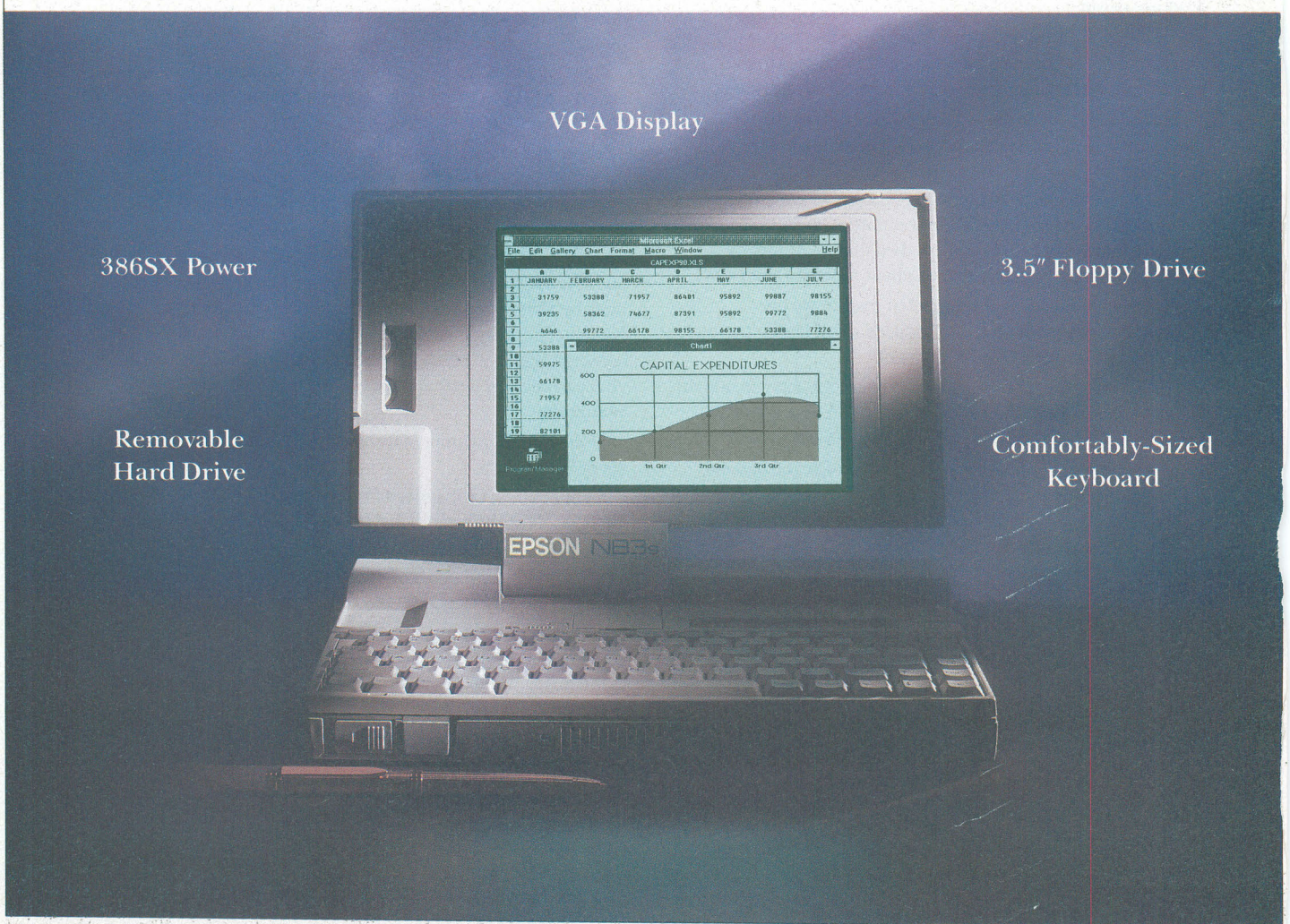
The user slides the laptop into the station that remains fixed in the office, where it's connected to a network and a host of peripherals.

Ward said that research and development are central to realizing the log-term goals for the laptop market.

NEC ranks second only to IBM in research and development expenditures, with almost $5 billion invested annually.

Stan Ossias is Laptop Marketing Manager, Computer Systems Division, at NEC Canada, Inc.

Any rese to a desktop purely in



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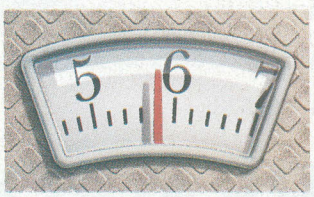

Here is where the resemblance ends: the NB3s weighs just 5.8 pounds and measures 8.4 x 11.8 x 1.7 inches.

By any measure of performance, the Epson NB3s is a giant among notebooks. In fact, you could say it is the perfect computer for the portable user who wants everything. Except compromise.

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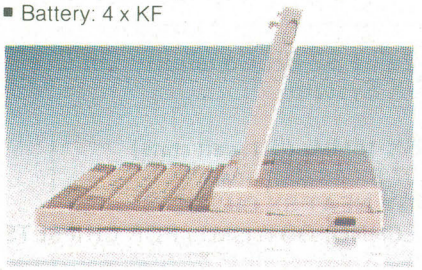

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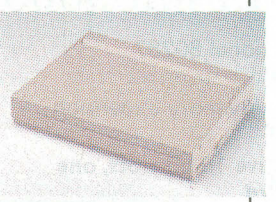

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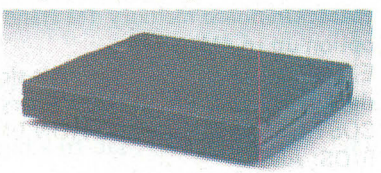

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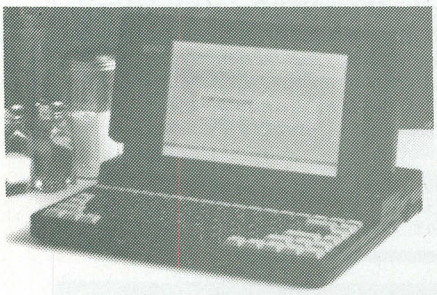
The GRiD 1720

Well-respected in the industry as a purveyor of high-quality field systems, GRiD has come through once again, this time with its Model 1720 notebook computer.

Featuring a 16MHz 80C286 microprocessor and two internal drives, the unit provides users with true notebook portability at *under* 3.2 kg (7 lbs.). The industry benchmark for classification as a notebook is 3.6 kg (8 lbs.) or fewer.

Standard memory in the 1720 is 1 megabyte, and this is expandable to either 3Mb or 5Mb. The 20Mb internal hard drive, which by today's standards is somewhat low in capacity for most power users, is upgradable with an optional 60Mb unit. (GRiD is not the only company who supplies the 20Mb drive as standard in its notebook computers; it is the standard fair from most manufacturers.)

The GRiD 1720's 9-inch VGA display is of the triple supertwist backlit type and is capable of displaying 16 gray scales. This high-quality display is certainly ideal for field applications such as order taking, inventory control, form filling, spreadsheets etc.



The power system on GRiD 1720 is comprised of a three hour, internal Ni-Cad battery that sports a recharge time of only two hours. GRiD claims that users can get up to 3.5 hours use, but they are also quick to point out that this will vary depending on the options installed and the amount of floppy and hard drive access. For users who travel and need the security of additional battery power; a second battery can be purchased from GRiD.

There is a manually activated standby mode that allows for work to be interrupted for extended periods without turning the 1720 off. The length of time that you can leave the unit in this mode depends largely on the amount of RAM installed, and whether the battery is fully charged or if there is no battery or AC adapter connected.

What good would a portable computer of any kind be without some kind of communications capability? Well, the 1720 has a built-in 2400 baud Hayes-compatible modem for connecting up with the mother ship. A nice feature that should be standard on all portable computers, regardless of their size.

Options available for the GRiD 1720 notebook computer include the aforementioned 60Mb hard drive, expandable memory to 3 or 5Mb, an automotive power adaptor, and 80C287 coprocessor, and the ever optional carrying case.

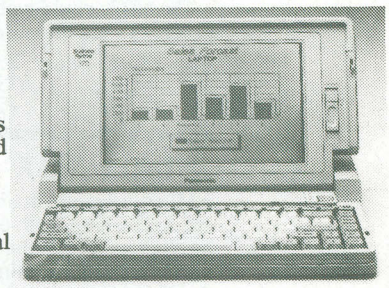
The 1720 is priced at $4,418 in its standard configuration, and is available through GRiD's worldwide direct sales and support organization as well as from application-specific value added resellers. GRiD is launching the 1720 heavily at the corporate and government markets; markets where portability, quality, support and price are a must on the buying check list. The GRiD warranty is one year on parts and labour.

GRiD Systems Canada Inc., 1 Concorde Gate, Suite 200, Don Mills, ON M3C 3N6;
Ph: (416) 446-1555; Fax: (416) 446-6136.

Panasonic Business Partner 270

The Business Partner 270, aside from its rather stodgy name, is in every way a slick piece of equipment. Weighing in at 6.9 lbs — the far end of the "notebook" class — the 270 incorporates just about all the nice features most users would want.

Processing is swift, courtesy of a 16 MHz 286 chip. This isn't exactly a substitute for 386SX capability, but it should keep up handsomely as far as sheer speed is concerned. The hard drive is 20 Mb, with a respectable 25 msec average seek time. A single 3.5-inch floppy drive is tucked into the right-hand side of the box.



Video display is true 640x480 VGA, with up to 16 gray shades. This is highly standardized, and very easy on the eyes. The backlight has several levels of intensity, and provides clear viewing over a good range of angles.

The keyboard is subject remarkably to few of the usual notebook compromises. The keys have a relatively long travel and a positive feel. The layout is compressed, but rational; arrow keys are set in a T at the lower right, and the Ctrl key — though not where originally intended — is at least easy to hit, at the bottom left. There's a Fn key for accessing the numeric keypad — embedded on the alphabetic area — but, mercifully, this key is inboard of the more-frequently used Ctrl. Function keys are undersized, but easily accessible across the top. The power switch is a recessed button just below the screen, where it's easy to get at, but unlikely to be pressed by accident.

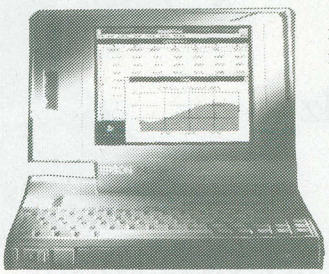
The Panasonic has a handy auto-resume mode, so that upon powering up you find yourself right where you left off. The battery pack is a small, flat module inset into the top-left-rear corner of the unit. It can be changed without disturbing the auto-resume state, which is maintained by a secondary internal battery. Considering the small size of the battery pack, carrying several spares would be no sweat.

Matsushita Electric of Canada Ltd. 5770 Ambler Dr., Mississauga, Ont. L4W 2T3
Ph. (416) 624-5010

The Epson NB3s

The NB3s – Epson Canada Ltd.'s latest addition to the 386SX- based notebook computer market – boasts an uncommon feature: it's *really* a notebook.

With other companies claiming "notebook" 386SX power, and instead delivering what should really be called a laptop, Epson remains true to its claim. The NB3s, in standard configuration, weighs in at a mere 5.8 pounds.



Forgetting semantics, the Epson NB3s is a significant entry into the world of notebooks. The company has kept today's mobile computer user in mind. With removable 20Mb or 40Mb hard drive, removable 640 x 480 VGA display, removable batteries and a docking station that holds up to 120Mb of removable hard disk storage, what more could the movable user demand but an almost totally removable machine?

The security and convenience benefits of the NB3s are substantial. In addition to the removability of the hard drive, the compact design of the docking station allows the user to convert the notebook into a semi-laptop, complete with handle. The overall transportable weight of the NB3s when docked to the station brings the total package to about ten pounds, which is highly competitive with other high-capacity laptop systems.

The backlit VGA display combined with an added 5Mb of RAM bring the NB3s enough power to run Windows 3.0 and OS/2 with satisfying ease.

Standard RAM on the NB3s is 1Mb, and the internal

high-density 3.5-inch 1.44Mb floppy. Operating speed is a user-selectable 16 or 8MHz. The LCD Panel/Status Indicator Bar is always a bonus feature on a laptop/notebook, and is becoming the norm for most new machines.

The Epson NB3s carries a manufacturer's suggested retail price of $5,608 for the 20Mb version, and $6,098 for the 40Mb edition. The docking station retails for $1,031.

The NB3s could well become the standard 386SX-based notebooks are measured against in the near future.

Epson Canada Ltd., 95 Mural Street, Suite 500, Richmond Hill, Ontario L4B 3G3;
Ph.(416) 881-9955; Fax: (416) 881-5765

Altima NSX

Miniaturization marches ever onward. Portable computers are now seeing, with ever-increasing frequency, the 80386SX microprocessor as the standard engine installed under the hood. With this in mind, users are finally able to cross the threshold from desktop to portable computing without paying a performance penalty. The Altima NSX is one such machine.

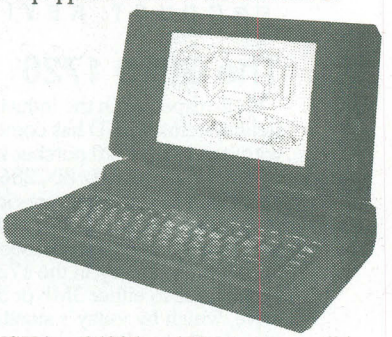
The NSX features a switchable 16 or 8 MHz 80386SX microprocessor with backlit 640 x 480 VGA in a 4.2 kg (9.3 lbs.) package. Altima is marketing the NSX as a notebook, but for this reviewer, notebook computers weigh in at fewer than 3.6 kg (8 lbs.). It's 14-inch by 11-inch by 2-inch footprint also makes it more of a laptop than a notebook.

One of the neat features of the NSX is the location of the battery compartment. It's located on the upper surface of the computer, just above the keyboard area. By releasing a couple of latches, the compartment cover pops off and reveals the Ni-Cad battery. Very handy!

The battery pack charges in five to six hours with the computer in use, but takes only a quick one hour and forty minutes from complete discharge with the power switch in the "OFF" position.

Standard system memory on the Altima NSX is 2 megabytes; this is expandable to 8 megabytes by inserting memory cards into a small compartment accessible through the bottom of the case. There is also built-in EMS 4.0 support.

Our review unit came equipped with a 25 millisecond 20 megabyte hard drive, but a larger, 60Mb Conner drive is available as an option. These days it seems almost necessary to have a minimum of 60Mb for the power applications that most users are putting on machines of this type. The standard floppy drive is a 3.5-inch, 1.44Mb internal type.



Also built-in to the NSX is a 2400 baud Hayes-compatible modem with Send Fax capability. A nice feature for those who need to send hard copy back to the office.

Other features include a 100-pin connector for an AT-bus expansion chassis; a 15-pin external VGA monitor output; parallel printer port; RS-232 port and external keypad port.

Options available for the Altima NSX include: an external 5.25- inch floppy drive; 80387SX math coprocessor; external fast charger for the battery pack; external numeric keypad; and a Microsoft compatible mouse. The carrying case is included with the computer as standard equipment.

The suggested list price of the Altima NSX notebook computer is $6495, however, dealers may sell for less.

BTI Computers Inc., 401 Magnetic Drive, Unit 36, Downsview, ON M3J 3H9;
Ph.(416) 665-2679; Fax: (416) 665-3975.

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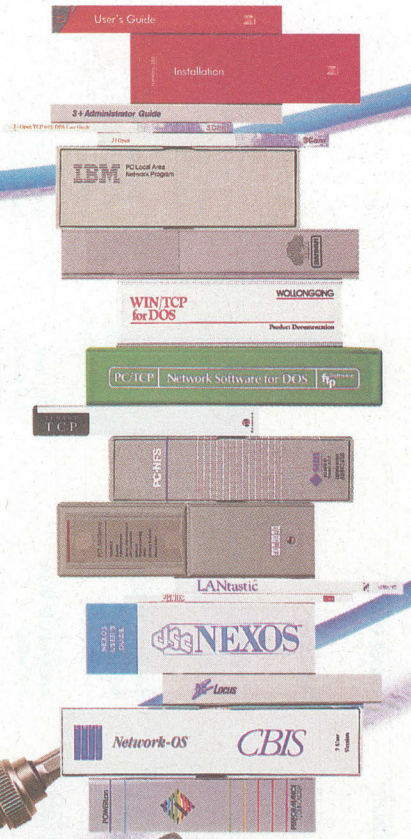

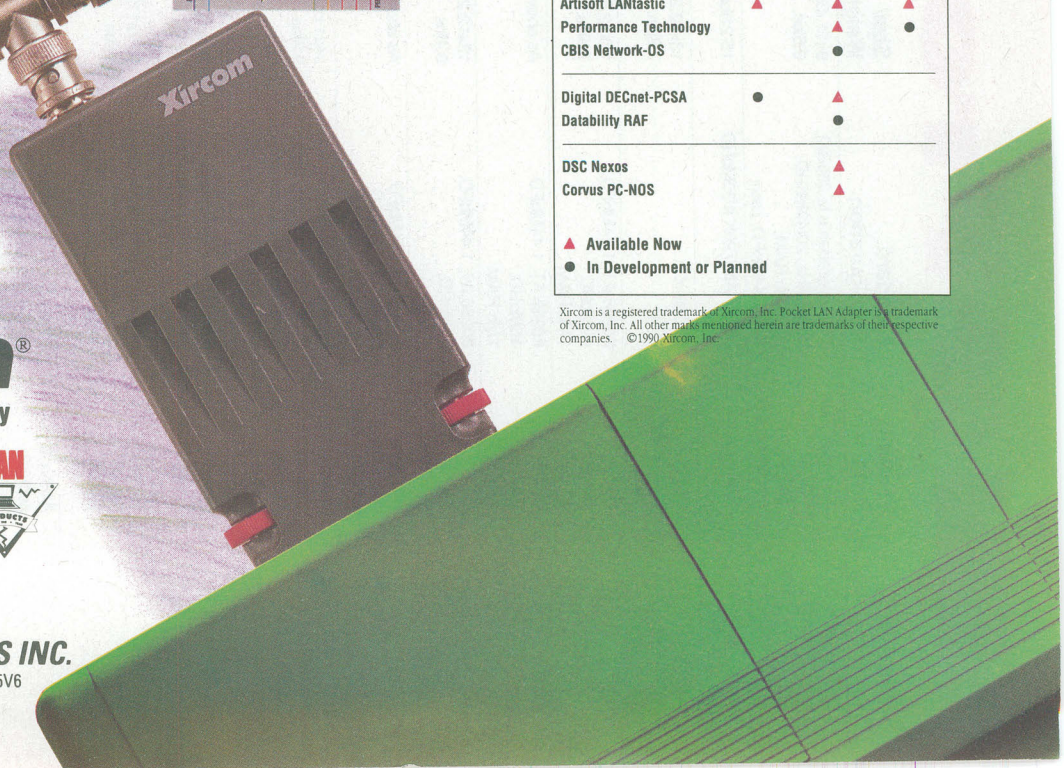

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LAN Manager	●	▲	
Banyan Vines	▲	▲	●
FTP Software PC/TCP	▲	▲	
Wollongong WIN/TCP	●	▲	
10SET TCP/IP		▲	
NCSA TCP/IP		▲	
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LN&P Product Spotlight

Company/ Phone	Product/ Price	Standard Configuration	Size/ Weight	Screen Type/ Resolution	Keyboard	Expansion Ports/Slots	Options	Warranty
AST Research (714) 727-7960	Premium Exec 286/12 386SX/20 $3,345/$3,846	286 (upgradable to 386SX), 12/20MHz, 20/40MbHD, 1/2/8Mb RAM, 3.5" 1.44MbFD, case	9x11.4x2.25" 6.5lbs.	CCFT backlit Supertwist LCD VGA 640x480	82 keys 101 key compatible	Modem, monitor, keyboard, keypad	Auto adapter, modem	1 year (2 year available)
Atari (Canada) (416) 479-1266	Stacy Laptop	2Mb RAM/720K fl/20MbHD	15.21lbs	Supertwist LCD/640x400	94 keys QWERTY	parallel, RS232C, Midi	N/A	90 days
Bondwell Canada Ltd. (416) 793-2363	B200 (notebook) $999	80C88 XT 2 FD	13x12.2x2.2" 7.2lbs.	Supertwist LCD 640x200	81 keys full stroke	N/A	Carrying case, 220V adapter, extra batteries	1 year
	B310 (laptop) $1,699	80286 AT, 1.44MbFD 40MbHD 1Mb RAM	13x12.2x2.2" 7.6lbs.	As above	As above	N/A	As above	1 year
	B310P (laptop) $2,799	80286 AT, 1.44MbFD 40MbHD, 1Mb RAM	As above	As above	As above	N/A	As above	1 year
	B310V (laptop) $3,499	80286 AT, 1.44MbFD, 40MbHD, 2Mb RAM	13x12.2x2.7" 8.4lbs.	Backlit VGA	As above	N/A	As above plus 5Mb RAM 80MbHD C cell batteries	1 year
	B310SX (laptop) $3,995	80386SX, 1.44MbFD, 80MbHD, 2Mb RAM	As above	As above	As above	N/A	As above plus 5Mb RAM	1 year
BTI Computers Inc. (416) 665-2679	Altima NSX (notebook) $6,750	80386SX,2Mb RAM EMS 4.0, 1.44Mb floppy, 20MbHD, 2400baud mod., send fax, DOS 4.01	14x11x2" 9.3lbs.	CCFT backlit LCD VGA 640x480, 32 gray scale	83 key with function and cursor control	100-pin AT-bus exp., external VGA, parallel, serial port	Ext. 5.25"/1.2Mb floppy, 80387 math coprocessor	1 year
	Altima I (laptop) $3,895	80286-16, 1Mb RAM EMS 4.01, 1.4Mb floppy 40MbHD, 2400 baud modem	15.7x11.8x3.9" 14lbs.	backlit LCD CGA, 640x480	101 key full function, detachable	1 8-bit PC-XT (ISA), ext. CGA, parallel, serial, keyboard, phone	Ext. 5.25/1.2Mb floppy, 80287 math 5Mb RAM, ext. battery pack	1 year
	Altima II (laptop) $4,295	80286-16, 1Mb RAM, EMS 4.01, 1.44Mb floppy 40MbHD, 24 baud modem send fax, DOS 4.01	15.7x11.8x3.9" 14lbs.	backlit LCD VGA 640x480	101 key full function, detachable	8-bit PC-XT (ISA), ext. VGA, parallel, serial, keyboard, phone	Ext. 5.25/1.2Mb floppy, 80287 math, 5Mb RAM, ext. battery pack	1 year
	Altima III (laptop) $6,750	80386SX-16, 1Mb RAM EMS 4.0, 1.44Mb floppy 40MbHD, 2400 baud modem send fax, DOS 4.1, mouse	15.7x11.8x3.9" 14lbs.	backlit LCD VGA 640x480	101 key	16-bit PC-AT (ISA) detachable external VGA parallel/serial	120MbHD ext. 5.25" floppy 5Mb RAM	1 year
	BTI III 286 (portable) $2,995	80286-16, 1Mb RAM, EMS 4.0, 1.44Mb floppy 1.2Mb floppy, 40MbHD	16x8x11" 20lbs.	backlit LCD VGA 640x480	86 key	2 8-bit PC-XT (ISA), full function 2 16-bit PC-AT (ISA) Ext. VGA, parallel, 2 serial, keyboard	80287 math, 16Mb RAM, ext. battery, car adapter, standard ISA board	1 year
	BTI III 386 (portable)	80386-20, 1Mb RAM, EMS 4.01, 1.44Mb floppy 1.2MB floppy, 40MbHD	16x8x11" 20lbs.	backlit LCD VGA 640x480	86 key full function detachable	1 8-bit PC-XT (ISA), 2 16-bit PC-AT (ISA), 32-bit, ext. VGA, parallel, 2 serial, keyboard	80287 math, 16Mb RAM, ext. battery, car adapter, standard ISA board	1 year
	BTI III 386/33 (portable) $4,895	80386/33, 2Mb RAM, 40MbHD 1.44Mb floppy, 1.2Mb floppy	16x8x11" 20lbs.	CCFT backlit LCD VGA 640x480	84 key full function	2 8-bit PC-XT (ISA) 2 16-bit PC-AT (ISA) Ext. VGA, parallel, 2 serial, keyboard	80287 math, 32Mb RAM, ext. battery, standard ISA board 80/120/300MbHD	1 year
Canara Technologies (416) 858-3000	Samsung S3600 (laptop) $3,000	80C286, 8 or 12MHz, 1Mb RAM, 40MbHD 3.5" 1.44MbFD	12.8x14.4x3.3" 16lbs. (w/battery)	CCFT 640x480	80 keys 12 function keys	Parallel, serial, keyboard VGA monitor, int. modem	20MbHD	1 year
Commodore Business Machines Ltd. (416) 499-4292	C286-LT (laptop) $4,495	80286, 20MbHD, 1.44MbFD, 1Mb RAM	7lbs.	Supertwist VGA 640x480	82 key full size	parallel, serial, modem, ext. VGA monitor	Modem, memory cards, battery, battery charger	1 year

Compaq Canada Inc. (416) 733-7876	LTE (notebook) $4,299	80C86, 3.5" 1.44MbFD 20MbHD, 9.54MHz 640K RAM	11x8.5x1.89" 6.2lbs.	Supertwist Compaq EL backlit	Standard spacing	N/A	Int. modem, adapter, Num. keypad case	1 year
	LTE/286 (notebook) $5,799/$6,499	80C286, 12MHz, 640K RAM, 3.5" 1.44MbFD 20/40MbHD	As above	As above	As above	N/A	As above	1 year
	SLT/286 (laptop) $7,999/$8,899	80C286, 12MHz, 640K RAM, 3.5" 1.44MbFD, 20/40MbHD	13.5x8.5x4.15"	VGA backlit Supertwist 14lbs.	Full size, detachable	8-bit/16-bit ISA	Modem, CD-ROM adapter, auto adapter, ext. battery charger, num. keypad	1 year
	SLT/386s/20 (laptop) $10,299/$11,399	386SX, 20MHz, 2Mb RAM, 3.5" 1.44MbFD, 60/120MbHD	As above	As above	As above	As above	As above	1 year
	Portable III $7,899/$8,899	286, 12MHz, 2Mb RAM 5.25" 1.2MbFD, 20/40MbHD	16x7.8x9.8" 20lbs.	Dual-mode gas plasma	Portable enhanced	As above	As above	1 year
	Portable 386 $10,899/$12,499	386, 32-bit, 20MHz, 1-10Mb RAM, 3.5" 1.44Mb, 5.25" 1.2MbFDs, 40/110MbHd	As above	As above	As above	As above	Modem, expansion unit, desktop pedestaly	1 year case
Computer Access Systems (CAS) (416) 477-8667	Daewoo DLT/386S (laptop) $3,995	386SX, 8/16MHz, 1Mb RAM, 3.5" 1.44MbFD, 40MbHD	362x330x80mm 13lbs.	Backlit LCD 640x480	81 key slide out	Parallel, serial, mouse, video, FDD, modem	2Mb RAM, modem, car adpater, case	1 year
Dell Computer Corp. (416) 764-4200	System 316T (laptop) $3,989	386SX, 16MHz, 1/2 Mb RAM 20, 40, 120MbHD, 3.5" 1.44Mb floppy	12.7x3.4x14.3" 15lbs.	Supertwist backlit LCD, 640x480 adjustable/detachable	83 key numeric 12 function keys	parallel, serial, half-length 8-bit	80387 math, monit., ext. 5.25", 101 key keyboard, num key ports, Dell fax/modem	1 year
	System 320LT (laptop) $4,789	386SX 20MHz, 1/2Mb RAM 20, 40, 120Mb HD, 3.5" 1.44Mb floppy	12.7x3.4x14.3" 15lbs.	Supertwist backlit LCD, 640x480 adjustable/detachable	83 key numeric 12 function keys	parallel, serial half-length 8-bit	80387 math, monit., ext. 5.25", 101 key keyboard, num key ports, Dell fax/modem	1 year
	System 212N (notebook)	80C286, 12MHz, 20Mb HD, 1Mb RAM, 3.5" 1.44Mb FD	8.5x11x2" 6.4lbs.	640x480 LCD VGA	85 key 3mm keystroke	2 exp. slots, modem slot	40 MB IDE HD	1 year
	System 320N (notebook)	386SX, 20MHz, 30Mb HD, 1Mb RAM, 3.5" 1.44Mb FD	As above	As above	As above	As above	60Mb IDE HD	1 year
EMJ Data Systems (519) 837-2444	Acer AnyWare 1100LX (laptop) $6,995	386SX, 1Mb RAM, 3.5" 1.44MbFD, 40MbHD	10.5x35x21.5cm 6.1Kg	TSTN LCD 640x480	82/83 keys Numeric keypad Function keys	Serial. parallel, mouse, monitor, keypad, modem	5Mb RAM, modem, ext. 5.25" FD, keypad, additional battery	1 year
Epson Canada Ltd (416) 881-9955	Equity LT-286e (laptop)	80286, 1Mb RAM, 3.5" 1.44Mb FD, 20MbHD 8/12MHz	3.5x12.7x14" 13lbs	NTN LCD 640x480	84 key	"3-way expansion system" modem slot, 2/3 size expansion slot	20/40 removable internal modem AC adapter	1 yeary
	Equite LT-386SX (laptop)	386SX, 2Mb RAM, 3.5" 1.44Mb FD, 20Mb HD 8/16MHz	3.7x12.7x11.7" 13lbs.	As above	85 keys w/ separate cursor keys	As above,	As above	1 year
	NB3s (notebook)	80386SX, 1Mb RAM, 3.5" 1.44Mb FD, 20Mb removable HD, 16MHz	1.7x8.4x11.8" 5.8lbs. w/battery	Backlit VGA 640x480 removable	85 keys	As above, S/P/VGA/numeric keypad	Expansion unit (120Mb removable HDD, built-in AC/DC)	1 year
Everich Computer Systems Inc. (416) 731-8686	E6200H (laptop) $3,095	80286, 12MHz, 1Mb RAM 3.5" 1.44MbFD, 40MbHD	13x11x3" 11.5lbs.	Supertwist LCD EGA 640x400	84 key	Ext. port, EGA port	Modem, 10/22 keypad, 2Mb SIMM RAM, battery pack	1 year
	E8400 (laptop) $3,095	80286 NEAT (as above)	13.5x13.5x4" 15lbs.	Gas plasma 640x400	As above	Proprietary slot, EGA port	Ext 5.25"FD, 2Mb ZIP RAM	1 year
	E-9200V (laptop) $4,395	386SX, 16MHz, 1Mb RAM, 3.5" 1.44FD, 40/100MbHD	As above	As above	As above	8-bit half height, EGA port	Modem card, 4Mb SIMM RAM, 10/22 key keypad, power adapter	1 year
	E9400H	386, 20MHz, 2Mb RAM	15.5x16x4"	Gas plasma	101 key	8-bit half height,	Modem card, 4Mb RAM	1 year

LN&P Product Spotlight

Company/ Phone	Product/ Price	Standard Configuration	Size/ Weight	Screen Type/ Resolution	Keyboard	Expansion Ports/Slots	Options	Warranty
Everich (cont'd)	(laptop) $6,695	3.5" 1.44MbFD, 40/100MbHD	17.5lbs.	640x480	full function	16-bit full height 32-bit RAM card slot	card, 5.25"FD, power adapter	
Fujikama (800) 265-7761	386A/386B (laptops)	386SX, 16MHz, 2/4Mb RAM 40/80MbHD, 3.5" 1.44MbFD	14x11.26x3.23"	VGA, 640x480	Full function detachable	parallel, serial	N/A	1 year
FutureTron (416) 477-8901	TRON 6200 (laptop) $2,900	1Mb RAM, 40MbHD	11.5lbs.	Backlit Supertwist LCD EGA	84 keys	N/A	Battery pack, 2Mb RAM	1 year
FutureTron (cont'd)	TRON 9200 (laptop) $3,400	1Mb RAM, 40MbHD	14lbs.	Gas plasma EGA	84 keys	1 half slot	4Mb RAM, keypad	1 year
	TRON 9400 (laptop) $6,000	2Mb RAM	17.5lbs.	VGA	101 keys	1 full size 16-bit	4Mb RAM, external 5.25"FD	1 year
GoldStar Technology (408) 432-1331	GS500 laptop	286, 12.5MHz, 640K RAM, 3.5" 1.44MbFD, 20MbHD	13x13.4x3.9"	Gas plasma, 640x400	83 keys	Modem, proprietary	2.64Mb RAM, numeric pad	1 year
	GS520 laptop	386SX, 16MHz, 1Mb RAM, 40MbHD, 3.5" 1.44MbFD	12.6x13.9x2.5" 12.8lbs.	Backlit Supertwist LCD VGA 640x480	81 keys keypad,	Modem, serial, monitor, keypad	5Mb RAM, keypad, battery pack, case	1 year
	GS620 notebook (avail. March '91)	386SX, 20MHz, 2Mb RAM, 3.5" 1.44MbFD, 40MbHD	11x8.5x2.0	Supertwist LCD VGA 640x480	81 keys w/F11,F12 support	2 proprietary slots, serial, parallel	Battery pack, modem, 4Mb RAM	1 year
GRiD Systems Canada Inc. (416) 446-1555	1450sx (laptop) $6,480/$7,160	386SX, 16MHz, 1Mb RAM, 3.5" 1.44MbFD, 20/40MbHD	11.5x12.5x2.6" 7.9lbs.	Backlit LCD VGA 640x480	82 keys	Two RS232 serial, Ext. monitor, parallel printer, Ext. keyboard/keypad	3/5Mb RAM, MNP 2400 baud modem	1 year depot
	GRiDcase 1550sx (laptop) $5,881	386SX, 20MHz, 2Mb RAM, 3.5" 1.44MbFD, 60MbHD	15x11.5x2.5" 12lbs.	As above	77 keys ISOpoint device	As above, expansion cartridge bus	387sx coprocessor, 4/8Mb RAM, 120MbHD	1 year depot
	GRiDcase 1520/ 1530 (laptop) $5,215	80C286 12MHz/80386 12.5MHz 3.5" 1.44MbFD, 20/40MbHD	As above	Backlit LCD CGA/VGA or gas plasma 640x480	72 keys 12 function keys	As above	2/4/8Mb RAM (1530 only), 387sx math, modem	1 year depot
	GRiD 1720 (notebook) $4,418	80C286, 16MHz, 20Mb HD, 3.5" 1.44MbFD, 1Mb RAM	12.2x10.1.7"	Backlit LCD VGA 6.8lbs. 640x480	84 keys	Serial, parallel, 3.5mm stroke	5Mb RAM, 60Mb HD RGB, ext. keyboard	1 year depot
	1810 (notebook) $3,914	V20 10MHz, 20Mb removable HD, 1Mb RAM	12x10.4x1.8" 6.7lbs.	Backlit or reflective LCD EGA 640x400	81 keys 12 function keys	RS232 port, parallel, phone jacks	2Mb RAM, peripheral disk cartridge, modem	1 year depot
	GRiDPAD (pen-operated) $3,318	80C86, 10MHz, 1Mb RAM, 256/512K capacity	9.25x12.4x1.4" 4.5lbs.	Reflective LCD CGA 640x400	Pen-operated	Serial, exp. bus, keyboard		1 year depot
Hitachi (Canadian) Ltd. (416) 826-4100	HL500 (laptop) $6,995	80386SX/8 or 16 MHz 1Mb RAM, 3.5" 1.44Mb FD	8.5Kg	B/W LCD 640x480	86 keys detachable	1 8-bit half length 16-bit full length	20, 40, 80 MbHD 4Mb exp. card carrying case	1 year
	HL500C (laptop) $12,895	As above	8.7Kg	Colour LCD 640x480 VGA	86 keys detachable	1 8-bit half height 16-bit full length 80, 100MbHD	4Mb exp. car carrying case	1 year
Hyundai Electronics Canada (416) 882-5255	Super LT5 (laptop) $6,500	386SX, 16MHz, 2Mb RAM, 40MbHD, 3.5" 1.44MbFD	–12lbs.	Backlit LCD VGA 640x480	Full function	Parallel, serial, monitor, floppy	Math coprocessor modem, case	18 months
IBM Canada (416) 474-3900	PS/2 P75 486 (portable) $21,395/$25,245	486, 33MHz, 8Mb RAM, 160/400MbHD, 3.5" 1.44MbFD	20lbs.	Gas plasma VGA 640x480	PS/2 enhanced	Ext. SCSI, ext. storage device, serial, parallel, video, 4 card slots, mouse	16Mb RAM	1 year
Koslap Computer (416) 731-2078	Laplus A-6200H (laptop) $2,995	80286,1Mb RAM 3.5" 1.44MbFD, 40MbHD	13x11x3" 11.5lbs.	Supertwist LCD EGA 640x400	84 key	Proprietary	Modem, keypad, memory expansion,	1 year
	LaplusA-9400H (laptop) $6,995	386, 20MHz, 2Mb RAM 3.5" 1.44MbFD, 100MbHD	15.5x16x4" 17.5lbs.	Gas plasma VGA	101 keys	16-bit, 8-bit	387 math, 4Mb RAM	1 year
	Laplus A-9200V (laptop) $3,995	386SX, 16MHz, 1Mb RAM, 3.5" 1.44FD, 40MbHD, case	4.5x13.5x13.5"	Gas plasma VGA	84 key	8-bit half height,	Modem card, memory expansion, num pad	1 year

	Laplus A-2200 (notebook) $4,295	386SX, 1Mb RAM, 3.5" 1.44MbFD, 20MbHD	11.5x8.25x2" 6lbs.	LCD Supertwist VGA	82 keys	N/A	Modem card, 2Mb SIMM RAM	1 year
Laptech Systems Inc. (403) 286-3949	Dauphin 1000 (notebook) $4,995	386SX, 20MHz, 2Mb RAM 20MbHD	2.25x12.5x11.25 6.5lbs.	VGA, 640x480	79 keys 12 functions	Floppy, parallel, 2 network ports	Expansion chassis, 60MbRAM, 387 math	1 year 48hr depot service
	Dauphin 2000 (notebook) $4,995	386SX, 16MHz, 2Mb RAM, 40MbHD	3.9x12.2x14.3" 10.1lbs.	As above	91 keys 12 function dedicated numeric	2 serial, parallel, proprietary internal	4Mb RAM, exp. chassis, 100MbHD	As above
	Dauphin 3000 (laptop) $14,995	386SX, 20MHz, 2Mb RAM, 200MbHD	4.25x14.5x13" 16lbs.	Active matrix VGA 640x480	94 keys 12 function dedicated numeric	2 serial, parallel expansion chassis	8Mb RAM, math coprocessor	As above
	Dauphin LapPro 386SX $4,995	16MHz, 2Mb RAM, 40MbHD	3x12x16" 16lbs.	VGA, 640x480	75 keys 12 function keys	2 serial, parallel, 1 ISA half height	4Mb RAM, 100Mb expansion chassis	As above
	Dauphin LapPro 286 $3,795	12MHz, 1Mb RAM, 40MbHD	As above	CGA, 640x400	75 keys dedicated numeric	As above	As above	As above
	Dolch Portable 486 $21,995	33MHz EISA, 2Mb RAM 100MbHD	10x8x16" 20lbs lunchbox	Gas plasma VGA or TFT Colour 640x480	86 keys, 12 function, dedicated numeric	2 16-bit internal, 2 32-bit internal	Add-on back pack gives 24Mb RAM, 200MbHD	1 year On-site
	Dolch Portable 486 $17,995	25MHz, 2Mb RAM, 100MbHD	As above	As above	As above	As above	As above	As above
	Dolch Portable 386 $10,995	25CMHz, 2Mb RAM, 40MbHD, column RAM cache 32K	As above	As above	As above	As above	As above	As above
	Dolch Portable 386SX, $8,995	20MHz, 2Mb RAM, 40MbHD	As above	Gas plasma VGA 640x480	As above	As above	As above	As above
	Dolch Portable 386SX, $7,995	16MHz, 1Mb RAM, 40MbHD	As above	As above	As above	As above	As above	As above
	Dolch Portable 286, $5,495	12MHz, 1Mb RAM, 20MbHD	As above	As above	As above	As above	As above	As above
Mitsubishi Electric Sales Canada (800) 387-9630	mp286L (laptop) $4,099/$5,199	80286, 8/12MHz, 640K RAM, 3.5" 1.44MbFD, 20/40MbHD	12.3x14.2x3.5" 14.6lbs.	LCD CGA 640x400	86 keys	4 internal slots, monitor, 2 serial, parallel, keypad	Math, 2Mb RAM, 5.25" FD, modem, case	1 year
National Computer Products (NCP) (416) 675-0125	Copam LT386XL (laptop) $5,495	386SX, 8/16MHz, 1Mb RAM, 3.5" 1.44MbFD, 40MbFD	15x11x3.5" 12.1lbs.	LCD VGA 640x480	91/92 keys detachable	RS232 port, parallel, VGA, FDD, 16-bit slot	4Mb RAM, 2x16-bit slots, modem, car adapter, ext. 5.25"FD	1 year
NEC Canada (416) 795-3500	UltraLite 286V (notebook) $5,999	1Mb RAM, 20MbHD	12.4x9.6x1.7" 6.5lbs.	EL backlit Supertwist LCD VGA 640x480	78 keys 12 function keypad, sep. cursor keypad	CRT, serial, parallel, FDD cable/exp. bus ports	4Mb RAM, modem, ext. FD, battery cartridge, charger, case	1 year
	UltraLite (notebook) $2,499	640K RAM, 12MbHD, ext. FD	11.75x8.3x1.4" 4.4lbs.	EL backlit Supertwist LCD CGA 640x200	78 keys, 12 function	Serial, modem, exp. port	Portable FD, parallel port & adapter, case, battery pack	1 year
	ProSpeed SX/20 (laptop) $8,799	386SX, 1Mb RAM 40MbHD, 3.5" 1.44MbFD	13.4x10.4x3.4" 11.8lbs.	CCFT backlit LCD VGA 640x480	Removable 83 key 12 function keys 8 cursor	Serial, parallel, video, phone, RJ11 ports	4Mb RAM, SX/20 num board, modem, case	1 year
	ProSpeed 386SX (laptop) $7,799	386SX, 40MbHD, 1Mb RAM, 3.5" 1.44MbFD	12.9x14.9x3.36" 15lbs.	CTN VGA 640x480	82 keys, 12 function keys cursor control keys	As above	4Mb RAM, modem, expansion station, long-life battery, network card, battery charger	1 year
	ProSpeed 386 (laptop) $10,299	80386, 40/100MbHD, 2Mb RAM, 3.5" 1.44MbFD	13.62x15.35x3.94 17.5lbs.	Detachable CTN VGA (text) CCFT backlit	92 keys	As above w/docking station connector	4Mb RAM, modem, case	1 year
	ProSpeed 286 (laptop) $6,999	286, 1Mb RAM, 40MbHD, 3.5" 1.44MbFD	12.9x14.9x3.4" 15lbs.	CTN VGA 640x480	82 keys 12 function full cursor	As ProSpeed 386	As above	1 year
	ProSpeed CSX (laptop) $12,999	2-4Mb 80 nanosecond memory	15x14.4x4" 18.5lbs.	Colour LCD EGA 640x400	89 keys key/cursor pads	Parallel, serial, VGA, ext. FD, modem	2Mb RAM, modem, case	1 year

LN&P Product Spotlight

Company/ Phone	Product/ Price	Standard Configuration	Size/ Weight	Screen Type/ Resolution	Keyboard	Expansion Ports/Slots	Options	Warranty
NEC (cont'd)	MultiSpeed HD (laptop) $3,999	640K RAM, 20Mb HD, 3.5" 720K FD	13.6x12.5x3.6" 14.3lbs.	Detachable EL backlit LCD 640x200	85 keys help keys, num pad	Serial, parallel, monitor	Modem, case	1 year
	MultiSpeed EL-2 (laptop) $1,999	640K RAM, 2 x 720K FDs	13.6x12.4x3.25 11.5lbs.	Detachable CGA backlit Supertwist LCD, 640x200	85 keys 12 function, num pad	As above	As above	1 year
Ogivar Technologies (416) 513-6390	Internote 286 (notebook) $3,995	80C286, 12.5MHz, 1Mb RAM, 3.5" 1.44Mb FD, 20MbHD	12.3x10x2" 5.3lbs.	CFL backlit LCD VGA 640x480	82 keys	Serial, parallel, ext. VGA	3/5Mb RAM	1 year
Olivetti Office (416) 940-2245	M111 (laptop) $2,725	NEC U30 10MHz, 20MbHD	3.9x13x14.3" 14.9lbs.	Backlit LCD CGA 640x400	82/83 keys full size	1 XT half height	Up to 4Mb RAM num coprocessor, carrying case	1 year on-site
	M211/M211V (laptops) $4,725-$6,055	80286 16MHz, 20 or 40MbHD 1.44MbFD	As above	Backlit LCD CGA (640x350) or VGA (640x480)	As above	1 proprietary, 1 half height serial, parallel, mouse keyboard	As above	1 year on-site
	M316 (laptop) $6725	80386 16MHz 40MbHD 1.44MbFD	As above	Backlit VGA 640x480	As above	As above	As above	1 year on-site
Packard-Bell Electronics Inc. (416) 567-5700	PB286LP (laptop) $4,100/$4,480	286, 12MHz, 1Mb RAM, 3.5" 1.44MbFD 20/40MbHD	N/A	Backlit CGA	82 keys modem	Serial, parallel, FD, monitor, keypad	Modem, 2/5Mb RAM	1 year
	PB286NB (notebook) $4,000	286, 12MHz, 1Mb RAM, 3.5" 1.44MbFD, 20MbHD	11x8.6x1.9" 6.6lbs.	LCD CCFT CGA	79/80 keys 12 function	Serial, parallel, VGA video, mouse, ext. FD, keypad	Modem, 8Mb RAM	1 year
Panasonic (Matsushita Electric of Canada) (416) 624-5010	CF-170 (notebook) $2,999	V20, 10MHz, 640K RAM 20MbHD, 3.5" 1.44MbFD	12.2x10x.1.7". 5.9lbs.	Backlit LCD CGA 640x200	84 keys full function	Serial, parallel	1.6Mb RAM	1 year
	CF-270 (notebook) $4,299	80C286, 16/8MHz, 1Mb RAM, 3.5" 1.44MbFD, 20MbHD	12.2x10x1.7" 6.8lbs.	Backlit LCD VGA 640x480	84 keys, 3.5mm stroke full function	Serial, parallel, RGB, external keyboard	5Mb RAM	1 year
Philips Electronics (416) 292-5161	LTP3230 $7,399	286, 12.5MHz, 3.5" 1.44MbFD, 40MbHD	15lbs	LCD VGA	82 keys	Half-height XT slot	N/A	1 year
Roland DG Canada Inc. (604) 732-4446	DPC-2812 (laptop) $3,999.95	80286, 12MHz, 1Mb RAM, 40MbHD battery recharger	3.27x12.8x14.4" 15.9lbs.	Supertwist backlit VGA 640x480	80 keys, 12 function keys	Int. 2400 bps modem	(Standard) case, modem,Laplink III, DOS 4.01	2 years
Sanyo Canada Inc. (416) 421-8344	MBC-17NB (notebook) $5,000	80C286, 12.5MHz 1Mb RAM, 3.5" 1.44MbFD 20MbHD, Ni-Cad battery	7lbs.	Backlit LCD VGA 640x480	82 keys 101 key emulation	RS232 serial interface, Parallel printer interface	Internal modem 2Mb RAM, battery charger, spare battery	2 years
Semi-Tech Microcomputers Inc. (416) 475-2670	STM 5500 (laptop) $4,199	80286, 12MHz, 1Mb RAM, 3.5" 1.44MbFD, 40MbHD	38x36x8.6cm 14.9lbs.	Gas plasma EGA	Full size AT style	Full size AT card	Modem, expansion chassis, case	1 year
	STM 6500 (laptop) $6,199	386, 20MHz, 2Mb RAM, 3.5" 1.44MbFD, 40MbHD	As above	As above	As above	As above	2Mb RAM, modem, expansion chassis 100MbHD	1 year
Sharp Electronics of Canada Ltd. (416) 890-2100	PC 4702 (notebook) $2,495	640K RAM, 2 x 1.44Mb floppy drives	11x11.1x2.2" 8lbs.	DBL scan CGA 640x400	79 key full size	serial, parallel	Ext. video CRT, modem, 2nd serial 1Mb EMS RAM	1 year
	PC 4741 (notebook) $3,895	640K RAM 40MbHD 1.44Mb floppy	(as above)	(as above)	As above	(as above)	(as above)	(as above)
	PC 4721 (notebook) $3,395	640K RAM 20MbHD 1.44Mb floppy	(as above)	(as above)	As above	(as above)	(as above)	(as above)

Texas Instruments Inc. (800) 527-3500	TravelMate 3000 (laptop) US$5,499	386SX, 8/10/20MHz, 2Mb RAM, 20 or 40Mb HD, Internal FD	8.5x11x1.8"	640x480 VGA	79 keys w/embedded num keypad	Scuzzy interface		1 year
	TravelMate 2000 (laptop) US$3,999	286, 1Mb RAM, 20MbHD, 3.5" 1.44MbFD	8.5x11.1.4"	B/W VGA 640x480	As above	2 slots, 2 optional ports	Removable FD	1 year
	TravelMate LT286 Model 12 (laptop) US$3,199	286, 1Mb RAM, 20MbHD, 3.5" 1.44MbFD	8.2x11x3.2	Blue transmissive non-glare 640x200 CGA	84 keys, full size	N/A		1 year
Toshiba of Canada ISG (416) 470-3478	T1000 (notebook) $1,299	80c88, 4.77MHz 3.5" floppy, 512K RAM	6.4 lbs.	Supertwist LCD	Full-function		786K memory	1 year
	T1000XE/SE/LE (notebooks) $3,499/$2,799/ $3,599	80C86, 1/2/9Mb RAM, 9.54MHz, 3.5" 1.44Mb FD and/or 20MbHD,	–6 lbs.	Backlit LCD	Full function			1 year
	T1200 (laptop) $3,999	80C86, 9.54MHz, 1Mb RAM, 2x3.5" FD or 20MbHD w/1 3.5"FD	10lbs.	Backlit LCD	Full function	All standard ports		1 year
	T1200XE (notebook) $5,499	80C286, 12MHz, 1-5Mb RAM, 3.5" 1.44Mb FD, 20MbHD	–8lbs.	Sidelit LCD	Full function	All standard ports		1 year
	T1600 (laptop) $5,999-$7,499	80C286, 12MHz, 3.5" 1.44MbFD, 20 or 40MbHD, 1-5Mb RAM 2xremoveable, rechargeable batteries	11.4lbs.	Detachable sidelit EGA, 16 grey scales	Full function	All standard ports		1 year
	T2000SX (notebook) $7,999-$8,599	80386SX, 16MHz, 1-9Mb RAM, 3.5" 1.44MbFD removeable Ni-Hydride battery	–7lbs.	VGA sidelit LCD	Full function	Expansion port		1 year
	T3100e (portable) $5,599-$5,999	80286, 12MHz, 1-5Mb RAM, 3.5" 1.44MbFD, 20 or 40MbHD	–13lbs.	Gas plasma	Full function	All industry-standard ports		1 year
	T3100SX (portable) $8,999-$9,999	80386SX, 16MHz, 1-13Mb RAM, 3.5" 1.44Mb FD, 40 or 80MbHD 2xremoveable batteries		Detachable VGA gas plasma	Full size, w/numeric keypad	Two int. expansion slots	Battery conservation options	1 year
	T3200 (portable) $7,599	80286, 12MHz, 1-4Mb RAM, 3.5" 1.44MbFD, 40MbHD		EGA gas plasma	Full size, w/numeric keypad	Two int. expansion slots		1 year
	T3200SX (portable) $9,299-$10,699 (mono) $13,999 (colour)	80386SX 12 or 16MHz 1-13Mb RAM, 3.5" 1.44MbFD 40-120MbHD		256 colour LCD or VGA gas plasma	Full function separate numeric keypad	Two int. expansion slots		1 year
	T5100 (portable) $10,299 (100Mb)	80386 16MHz, 1-4Mb RAM, 3.5" 1.44MbFD, 40 or 100MbHD	15lbs.	EGA gas plasma	Full function	Int. expansion slot, dedicated modem slot		1 year
	T5200 (portable) $11,199-$13,199 (mono) $14,299 (colour)	80386 20MHz, 1-14Mb RAM, 3.5" 1.44MbFD, 100 or 200MbHD, combination lock		256 colour LCD or VGA gas plasma	Full function w/separate numeric keypad	Two int. expansion slots		1 year
Zenith data systems Canada (416) 232-2660	SlimsPort 286 (laptop) $5,999	80C286, 16/8MHz, 1Mb RAM, 20MbHD, 3.5" 1.44MbFD	12.4x11x2.58" 12.4lbs.	Backlit VGA 640x480	82 keys enhanced	Modem socket, RS232 serial, parallel, video, floppy exp. bus, RJ11	4Mb RAM, modem, ext. 5.25"FD, case, battery pack	1 year
	MinisPort HD (notebook) $3,999	20MbHD, Ext.FD, 1Mb RAM	12.4x9.8x1.3" 6lbs.	Backlit LCD	80 keys 101 key emulation	N/A	Modem, 3 slot expansion, 2Mb RAM	1 year
	SupersPort SX $6,599/$7,999	386SX, 1Mb RAM, 40/120MbHD	15.2x12.2x3.4" 16.8lbs.	Backlit LCD VGA	79 keys 101 key emulation	N/A	Modem, num. pad, ext. FDD, 2Mb RAM	1 year
	SupersPort 286E $5,599/$5,999	286, 1Mb RAM, 20/40MbHD	15.4x12.2x3.4 15.6lbs.	Backlit Supertwist LCD VGA	As above	N/A	As above, 3Mb RAM	1 year

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Experimenting With "Homemade" Pressure Sensors

by Donald Wilcher

Forces surround our environment on a constant basis. Forces provide the motion necessary to transport humans, animals, automobiles and communications from one point to another. Physicists are constantly studying this provider of motion to better understand how our society interacts with these forces. Engineers are also interested in forces to see how bridges, automobiles and electricicyl/electronics are affected by this parameter. One form of force that affects such systems as robots, automobiles and airplanes is pressure.

The discussion that is to follow will describe how pressure can be detected and processed through electronic means to indicate the amount exerted upon an object. Besides detection and control circuits being described, an explanation on how to build a "homemade" pressure sensor using common parts will be presented as well.

Homemade Pressure Sensor/Construction And Operation

A pressure sensor is a device capable of detecting an exerted or applied force. The force in the case of this discussion is mechanical in nature. To further explain this definition, a force exerted in a downward direction on to an object causing it to move is known as a "pushing" or an external force. Every object that rotates or moves in a linear path utilizes such a force. The homemade sensor that will be explained shortly is capable of detecting a pushing force. The sensor that I constructed, depending upon the amount of force applied to it, ranges from several hundred kilo-ohms (no pressure) to a few hundred ohms (maximum pressure). The resistance range was measured using an ohmmeter.

To construct such a device is relatively easy to do. The basic component for this sensor is a piece of conductive plastic foam used to provide anti-static protection for CMOS (Complementary Metal Oxide Semiconductor) transistors and integrated circuits. The sensor is simply a sandwich consisting of conductive foam between copper foil conductors. The size of the sensor can have a diameter ranging from a pencil eraser to a silver dollar. Copper foil and related material can be purchased from a hobby and craft store. Figure 1 shows the construction of a homemade pressure sensor. If copper foil is not available, an un-etched copper-clad circuit board or two pennies can be substituted. In both cases, the copper should be buffed to prepare it for soldering. A length of small diameter hookup wire will be soldered to each copper piece. The conductive plastic foam is available from many sources. If you don't

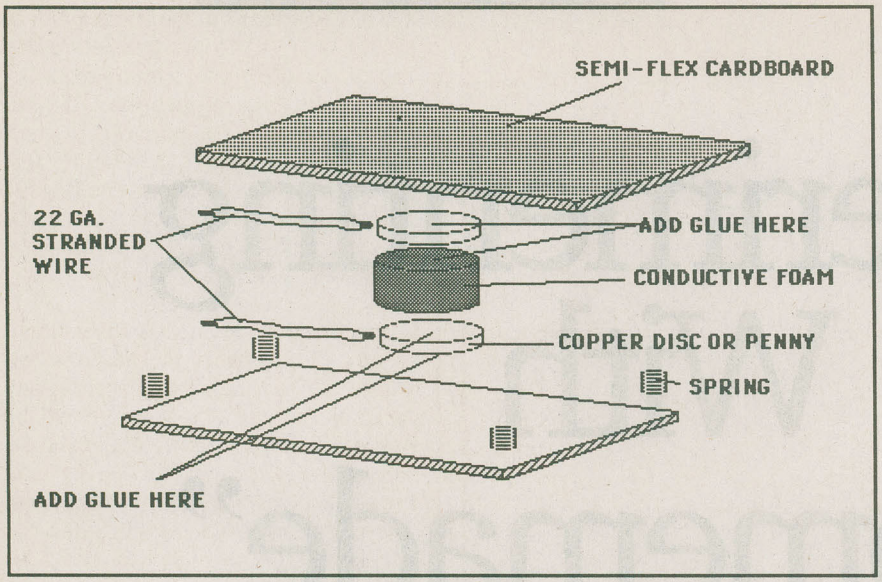

Figure 1. Construction of a Pressure Sensor Pad

happen to have any of this material lying around your lab or workbench, try an electronic supplier or university that purchases ICs in volume.

As discussed earlier, to verify that your sensor is assembled correctly, attach an ohmmeter to the device and by exerting a downward force onto the sensor note the change in resistance readings. With no pressure applied to the device, several hundred kilo-ohms should be displayed on the ohmmeter. As you apply more force, the reading should decrease. If you're unable to obtain such readings, visually inspect the sensor for poor solder connections and assembly of parts. If the sensor looks ok, check the setting of the ohmmeter for proper scale selection and measurement.

After verifying that the sensor works, to demonstrate its effectiveness as a pressure "variable" resistor, assemble the pressure sensor to a 1KΩ resistor as shown in Figure 2. With +5V applied across the resistive network and using a voltmeter to read the voltage, exert a force onto the sensor and note the voltage readings. Did the voltage go up or down as more force was applied to the device? The voltage should have increase because less resistance was in the circuit, the current level increased thereby, producing a higher voltage drop. This voltage divider network will be used quite extensively in the Hands On Projects and Experiments section of this article.

Applications

Pressure sensors can be found in circuits and systems that need to detect changes in pressure or force. A good example of this is that of a Load Cell used in electronic scales. Basically, a load cell is a "proving" ring which has pressure or force resistive components mounted inside of it. These resistive devices are wired in a Wheatstone Bridge configuration so that the two sides of the bridge tend to produce opposite changes in resistance. The voltage produced by the unbalanced condition of the bridge is then fed to a conditional amplifier where the signal is processed into a form which can be read in units of lbs. This information is then displayed on an LCD or LED readout. Figure 3 shows the proving ring configuration of the pressure sensors and a block diagram of an electronic scale.

Besides being able to tell how much force is produced by an object, pressure sensors can be used as safety devices in industrial applications. Pressure mats are quite often used in manufacturing and assembly facilities. Their purpose is to detect if a worker is present in a machine work envelope or zone. If a worker is detected in this zone via a pressure mat, the process equipment or machinery will be energized but will not initiate a machine cycle until the operator pushes the "START" cycle button. On the other hand, if an operator has not been detected the machine will be de-energized; therefore, few injuries will occur due to the pressure mat detecting the weight of a person within the equipment's work envelope.

Another useful and innovative approach to using pressure sensors is to control the speed of a dc motor. By applying pressure to the sensor using your hand, the speed of the motor will be reduced proportionally. Such a method of controlling a motor can be quite useful for power hand tools, blenders, and food processors. Instead of using ordinary switches, pressure sensors would be placed strategically on the unit according to how the hand grips the device. The life of the unit would be extended due to less mechanical wear of common mechanical

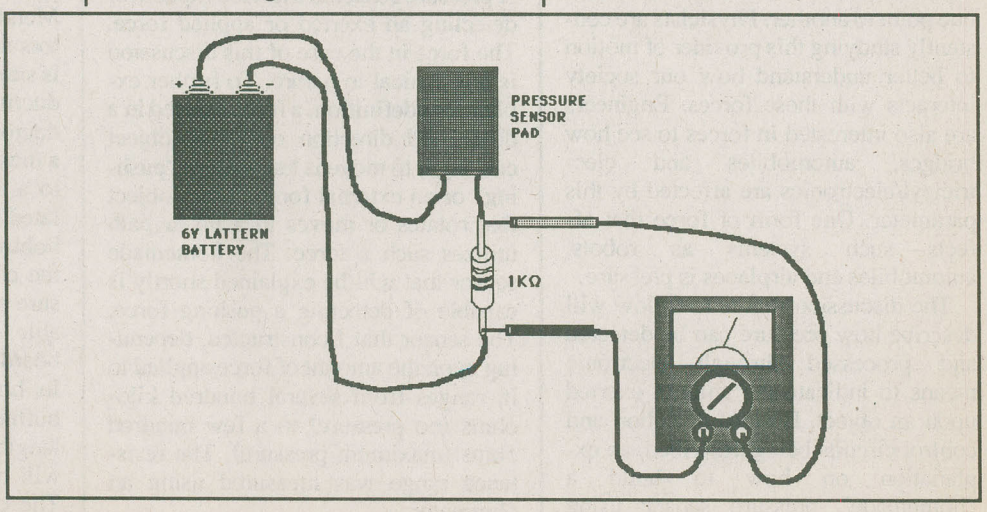

Figure 2. Pressure Sensor Test Circuit

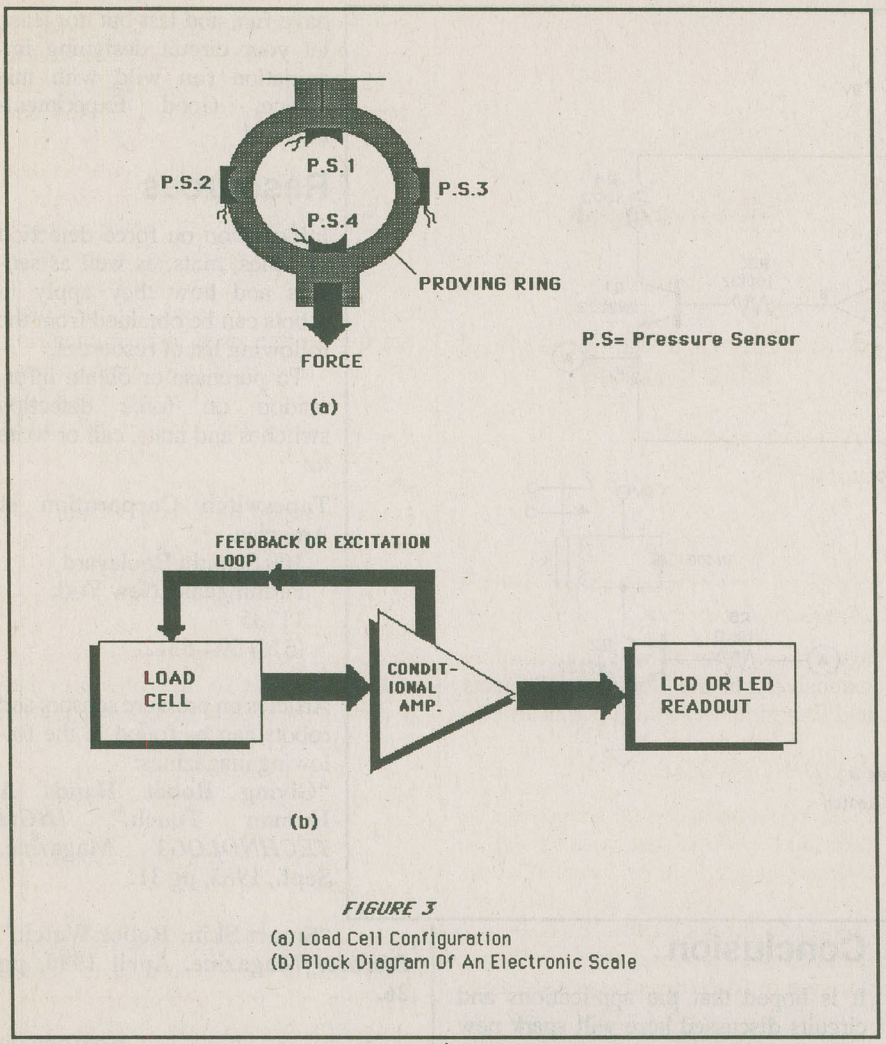

FIGURE 3
(a) Load Cell Configuration
(b) Block Diagram Of An Electronic Scale

switches. As stated before, the amount of force exerted by the hand would reduce motor speed. In the Hands On Project and Experiments section of this article, a circuit for controlling the speed of a dc motor will be described.

Finally, to wrap up our discussion of pressure sensor applications, this topic would not be complete without talking about robots and end effector or electro-mechanical grippers. In order for a robot to pick up an object, it has to detect its presence. Upon detection, the robot would then determine how large the object is and adjust its end effector or gripper accordingly. The amount of pressure that the end effector would exert on the object, again, is based on the force applied to the sensor and how large the object is. There are two excellent articles that describe how sensors help robots to sense and grip objects. See the **Resources** section for further information.

Hands On Projects And Experiments

Now that our homemade sensor has been assembled and tested, we are ready to construct some inexpensive circuits to investigate the sensor's interaction with outside forces.

Pressure Switch

Figure 4 shows the schematic diagram of a pressure activated switch. In operation, the switching limits of the comparator (configured using a 741 op-amp, P.S.(pressure sensor), R1 and R2) is set by the adjust potentiometer R3. Pressure applied to the sensor lowers its resistance, thereby increasing the voltage applied to the comparator's non-inverting input. Upon this voltage exceeding the reference limit determined by R3, the output approaches to near the positive supply voltage. Transistor Q1 is then turned on and illuminates the LED. The voltage at the anode point of the LED is fed to the transistor-relay driver circuit thereby, turning on Q1. Current flowing through the CE (Collector to Emitter) circuit of Q1 energizes the relay coil (K1) thereby, closing its associated contacts. The IN4001 silicon diode is used to suppress the inductive spikes generated by the energization/de-energization of the relay coil.

In terms of an application, this circuit could be used in a simple burglar alarm where the sensor(s) are placed at key locations around the perimeter of the house. Upon an intruder stepping on the sensor, the alarm will trip thereby (and hopefully) scaring off the assailant. There are many other applications for which this pressure switch could be used. Let your imagination run free with this circuit.

Pressure Sensitive Tone Generator

By applying force or pressure to the sensor in Figure 5, a tone of predetermined frequency would be generated. P.S., 1MΩ resistor and the .001μF capacitor establishes the timing and frequency of the tone heard through the speaker. If an oscilloscope is connected at pin 3 of the 555 timer and ground, the two waveforms illustrated in Figure 6 would be displayed. With no pressure applied, the output would be displayed as the top waveform of Figure 6. As more pressure is applied, the frequency would increase and the tone higher in pitch. This output response is illustrated as the bottom waveform of Figure 6. With this capability, this circuit would provide an audible alarm if the amount of weight of a preset value of a part in an industrial process control application was exceeded. As discussed in the previous circuit, see what other practical applications this circuit can be used in. Try changing the resistor and capacitor values and note the difference in output tones produced by this change.

Speed Controller For DC Motors

As discussed under the Applications section, the pressure sensor could be used to control the speed of a dc motor by the amount of force exerted on the

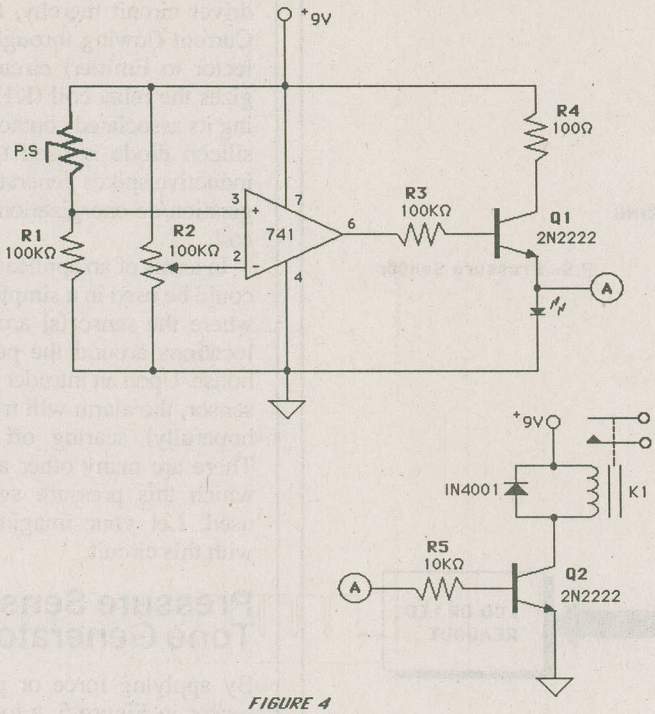

FIGURE 4
Pressure Switch

device. Figure 7 shows the circuit for a DC Motor Speed Controller. The 555 timer is wired as an astable or free running multivibrator circuit. As described earlier, P.S., 1MΩ resistor and the .001μF capacitor provide timing and frequency selection for the circuit. The output signal from pin 3 of the 555 is coupled to the transistor-motor driver circuit via 330Ω resistor. **NOTE:** When using transistors to drive dc motors, check the electrical specifications of the transistor to assure it has the current handling capabilities that the motor draws. Figure 8 shows the output waveforms measured between pin 3 of the timer chip and ground. Note that with no pressure applied, the square wave's time response between on and off is quite long. This condition would then allow the motor to run at maximum speed. But as more pressure is exerted, the time responses between on and off cycles is short, therefore, the speed of the motor is reduced.

Conclusion

It is hoped that the applications and circuits discussed here will spark new ideas for the homemade pressure sensor. So in closing, experiment, learn, have fun, and last but not least, let your circuit designing imagination run wild with this device. Good Experimenting! ! ! !

Resources

Information on force detection switches, mats, as well as sensors and how they apply to robots can be obtained from the following list of resources.

To purchase or obtain information on force detection switches and mats, call or write to:

Tapeswitch Corporation of America
100 Schmitt Boulevard
Farmingdale, New York
11735
(516) 694-6312.

Articles on pressure sensors and robots can be found in the following magazines:

"Giving Robot Hands A Human Touch," *HIGH TECHNOLOGY* Magazine, Sept., 1985, pg 31.

"Smart Skin: Robot Watch," *Discover* Magazine, April 1990, pg 26.

A 1 yr subscription to ***ROBOTICS NOW*** newsletter, which has informa-

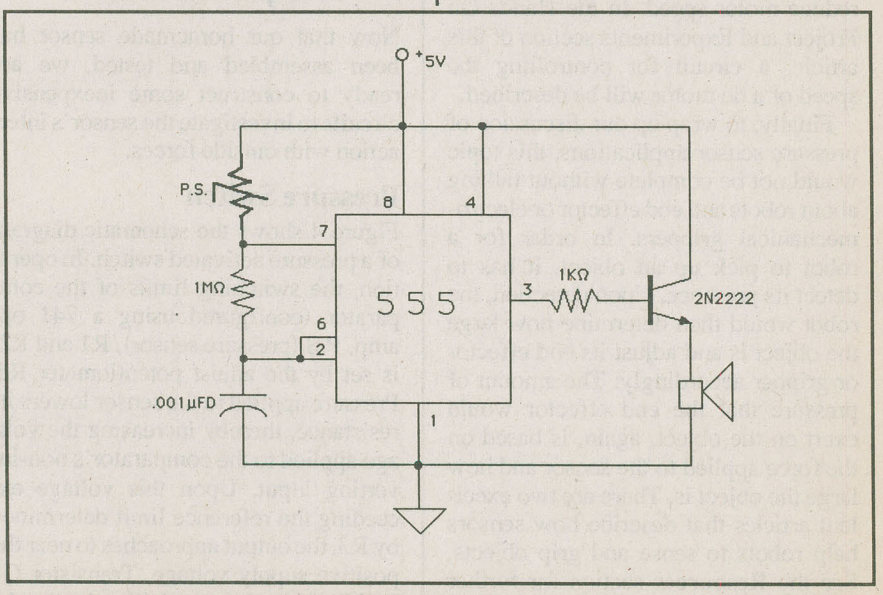

Figure 5. Pressure Sensitive Tone Generator

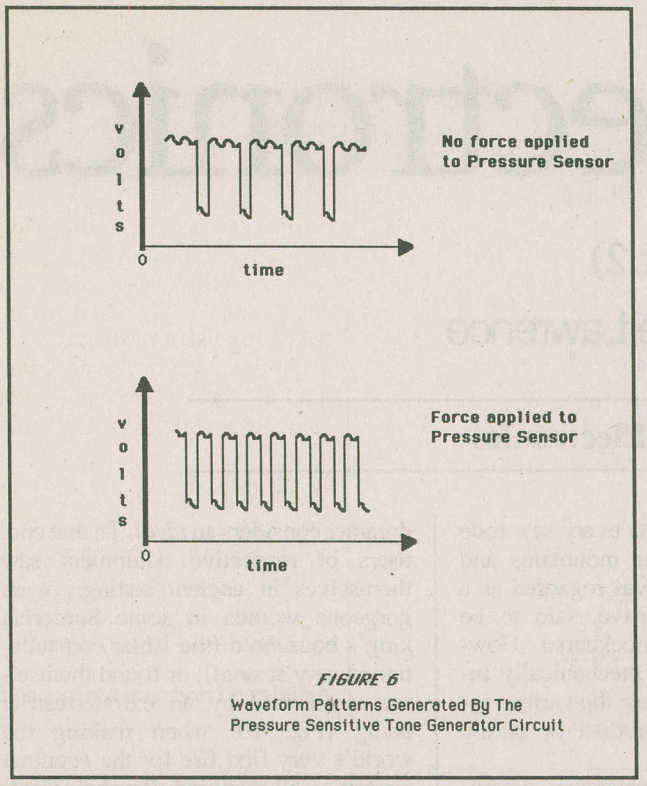

FIGURE 6
Waveform Patterns Generated By The
Pressure Sensitive Tone Generator Circuit

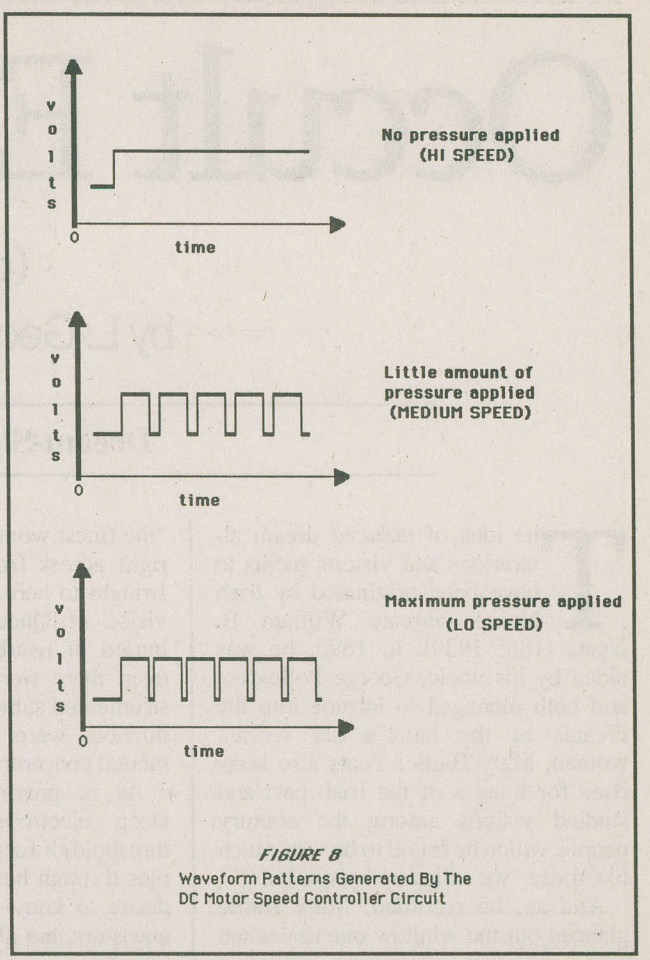

FIGURE 8
Waveform Patterns Generated By The
DC Motor Speed Controller Circuit

tion on electronics/computers and how they relate to hobby robots can be obtained from:

Donald Wilcher
Experimental Robotics Group
19940 Archer
Detroit, MI 48219
(313) 533-7251. ❐

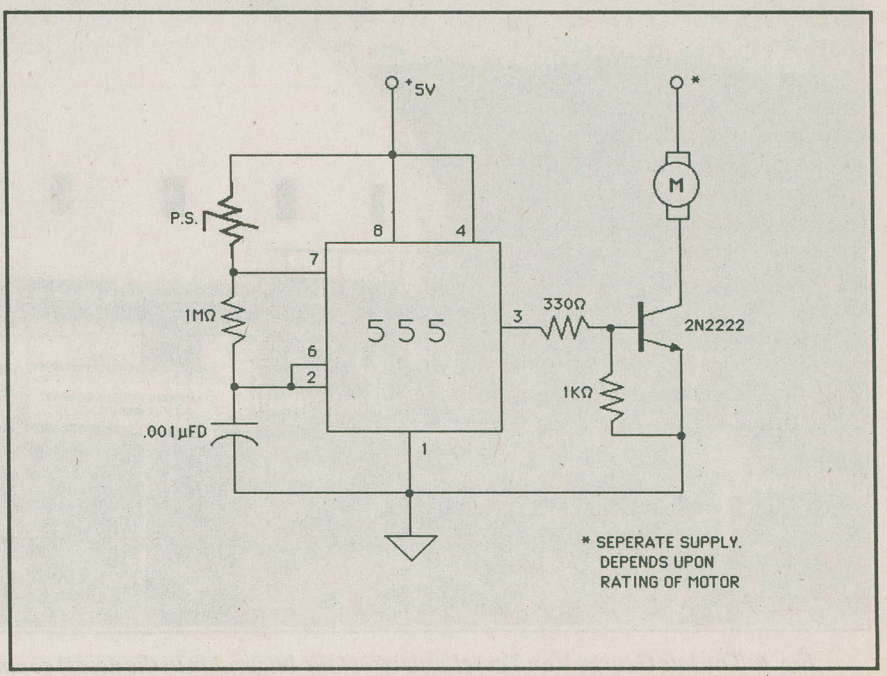

Figure 7. A DC Motor Speed Controller

FEATURE

Occult Electronics

(part 2)

by L. George Lawrence

Dream-Sleep Electronics

The idea of *induced* dream alterations and visions seems to have been originated by Irish Nobel laureate William B. Yeats (1865-1939). in 1895, he was aided by his uncle, George Pollexfen, and both managed to intrude into the dreams of the latter's old servant woman, Mary Battle. Yeats also searched for images of the Irish past and studied visions among the country people, which he found to be very much like those "we called up by symbols."

And so, he recorded, Mary Battle glanced out the window one day when "the finest woman you every saw rode right across from the mountains and straight to here." It was regarded as a vision of Queen Meave, said to be buried at nearby Knocknarea. However, there were no mechanically instrumented subterfuges; the various inductions were the product of purely mental concentration.

As in previous instances, dream-sleep electronics reside atop the threshold of fact and fiction. What ripples through here is not only an acute desire to know one's *true* origin and ancestors, but also to form a world the dreamer considers an *ideal*. To that end, users of respective equipment saw themselves in ancient settings, were gorgeous women in some Sumerian king's household (the Ishtar constellation is very strong!), or found themselves supervised by an extraterrestrial being (Fig. 10) when making the world's very first fire for the eventual benefit of all mankind. Psychologically, it is a peculiar form of eidetic imagery locked, in an intense dream state, with racial memories, charming stories, hopes, and powerful desires.

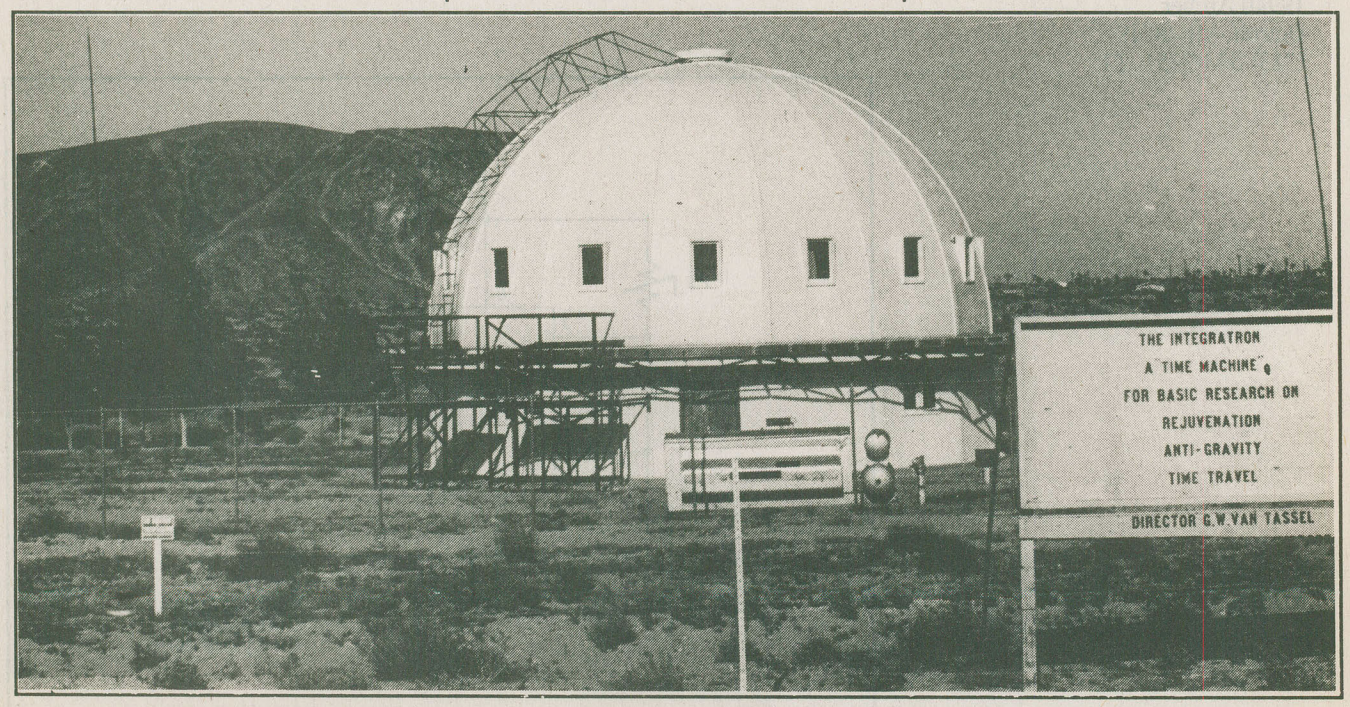

Fig. 6. The late George Van Tassel's electrostatic Integraton in the desert community of Landers (near Palm Springs, California). Compressed air for turbine drive was to be furnished by industrial air compressor in foreground. See text.

The technical evolution of dream-sleep apparatus is closely aligned with the development of *electrosleep* equipment in Russia in 1949. As shown in Fig. 11, 5 to 10 pulses per second are applied to electroded eye masks for inducing curative sleep without drugs. Currents range from about 5 to 25 ma and pulse durations from .2 to .3 ms. An excellent book, *Electrotherapeutic Sleep and Electroanaesthesia* (exerpta Medical Foundation, N.Y., 1967, International Congress Series No. 136), details this technique.

Occult electronics differ from the above in that not only all instrument controls are user-accessible, but allow the injection of *audiofrequency* harmonics into the electroded eye mask. Critical thereto is a *timer*, seen atop the generator in Fig. 12, to shut things off automatically in case the user falls asleep for too long a period of time. The mannequin, left, serves for mask storage and as icon of the target image he or she seeks to capture in dreams. Thus, then, a symbol in the Yeats tradition (icon) and tuneable electrical frequencies function in resonance, so to speak, to produce a desired dream structure.

Fig. 7. Moses'* Ark of the Covenant *in operation. Believed to be electrostatic radio for maintaining contact with tribal community. Ark has been variously imitated, but true principle of operation remains concealed.

Does it work?

Well, some people have excellent results, others none at all. Of course, the brains's physiology and complex integrations must be thoroughly understood before a universal principle of "dream susceptance" is made possible. EEG patterns might offer one avenue of approach, but these patterns are never simple or singular. We cannot extract just *one* independent variable. It is necessary to deal with a plurality of complex electro-chemical and other interactions. including traits of personality that characterize every individual as a unique autonomous entity.

Fig. 8. How Bible illustrators envisioned arrival of God at Mt. Sinai 3,500 years ago. Due to lack of technical semantics, starship was identified as "cloud." New interpretations gave rise to international best sellers and advanced genre of occult electronics.

Outlook

Reminiscent of the Roman god Janus, occult electronics projects two faces. One face shows the immutable laws of traditional physics, while the other represents that misty *something* from which our cosmic consciousness grew.

Most acute is and remains the question if life exists after death, here with a view at near-death phenomena. Credits belong to Dr. Raymond A. Moody, Jr., who with his popular books, *Life After Death* (1975) and *Reflections on Life After Life*, brought these phenomena to the public's attention.

There we have the dark, tunnel-like or tube-like passageway, a brilliant light or being, and the appearance of "death" relatives. To an individual carefully trained and steeped in scientific orthodoxy, all of this may, at first glance, seem absurd — at least until one encounters the near-death reports of very young children as yet unable to read, write, and totally ignorant of historical precedents. This is most dramatic when these little people, barely three years old, try to put into words splendours beyond comprehension. Strangely enough, what he or she has "seen" is in perfect *sync* (so to speak) with seasoned adults' observations.

Today, we know that biological continuum modulations (BCMs) prevail in space and can be detected by means of transducing *biosensors* combined with astronomical equipment. This phenomenon was first discovered accidentally in 1971 (during ecological remote-sensing research) and reported to the Smithsonian Institution, Washington, D.C., in 1972. The astrobiological signature plates (*biograms*) imply a communicative dimension down to cellular levels, yet are stunning in their simplicity.

Thus, then, it seems prudent to suggest that electronics should strive for a full integration with *biology*. At even more advanced levels, we need to know, for example, why an apparently

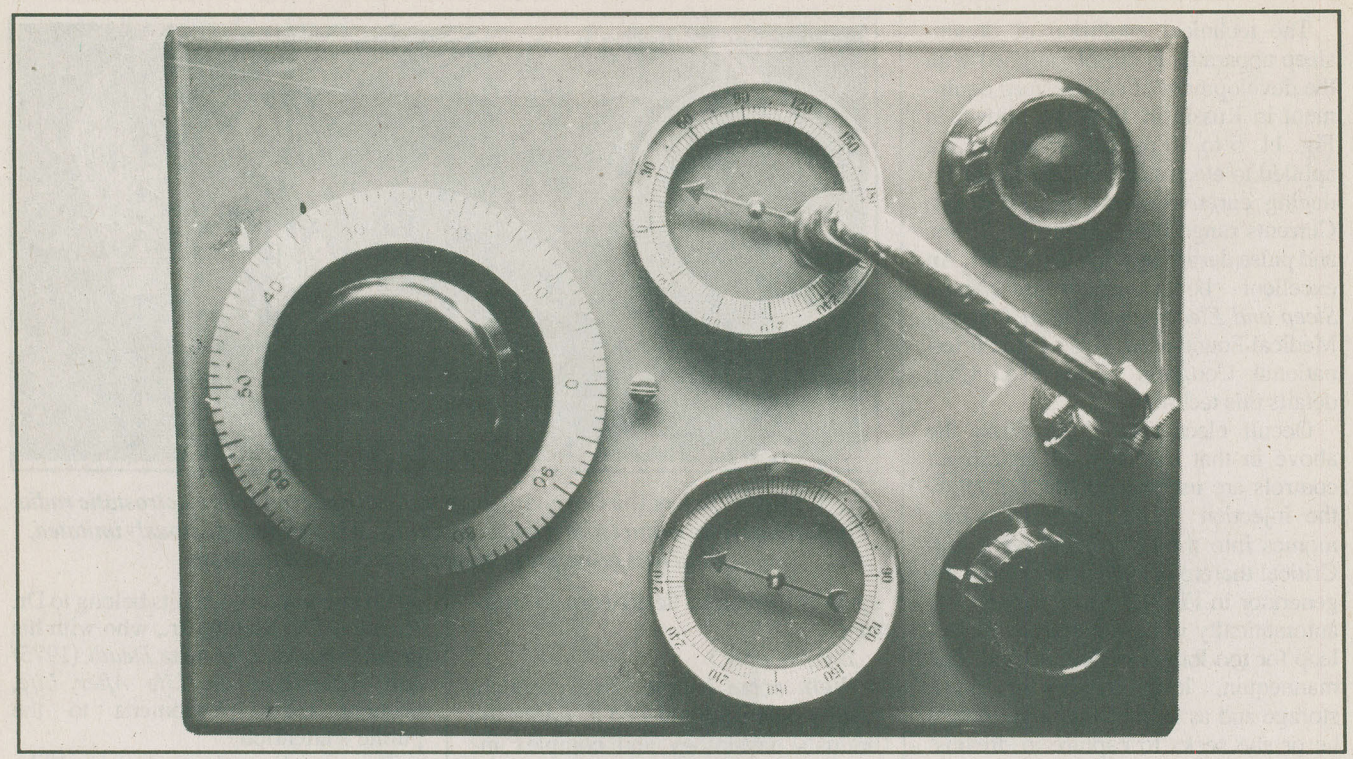

Fig. 9. The Magnetwin *instrument. Combines Geiger-counter and dual-compass assemblies for detection of electro-nuclear starships descending from orbit. An embodied* Exodus dimension. *See text.*

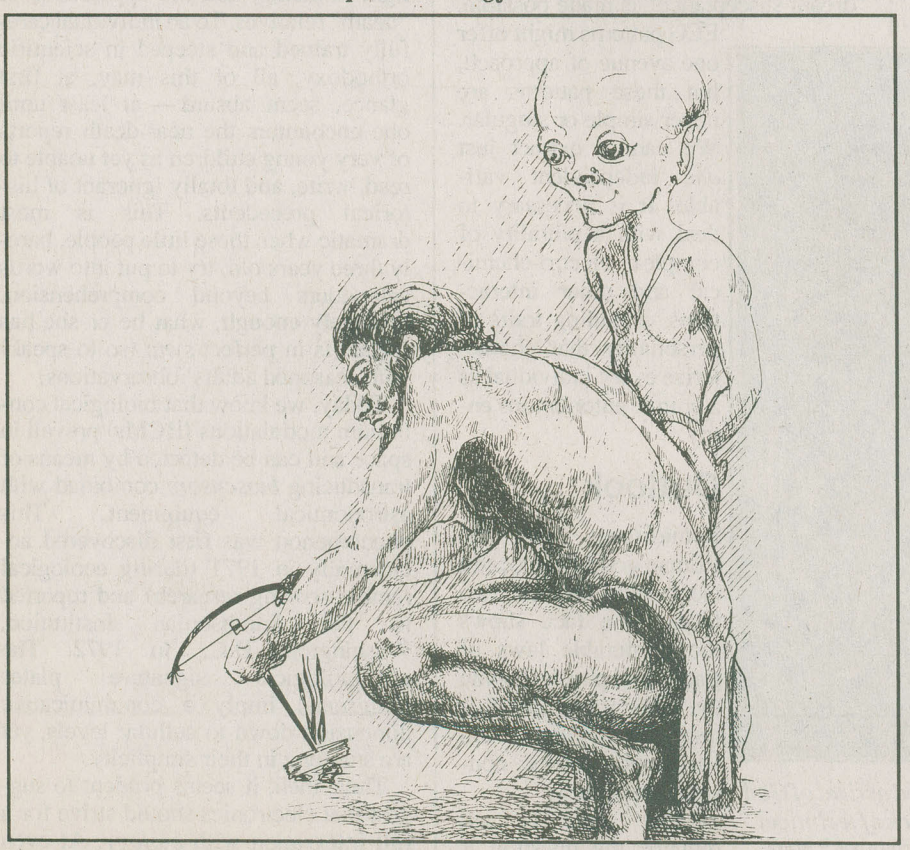

Fig. 10. A reported electro-dream image: Making first fire in history under tutelage of benign extraterrestrial. See text.

unrelated phenomenon such as premenstrual bloating appears common among women with demonstrated ESP abilities. As speculated on by Dr. William Roll (*Psychical Research Foundation*, Chapel Hill, North Carolina), the water-retaining hormone, vasopressin might play a part in these psychic constellations. "Progesterone," says Dr. Roll, "causes the release of vasopressin, and psychically talented women have been found to have unusually high premenstrual levels of progesterone." Dr. Roll believes that the hormone has a strong impact on the autonomic nervous system, giving rise to psi capabilities. A French endocrinologist, Dr. Alain Assailly, set the stage when he studied spiritualistic mediums in the 1950s.

So we may conclude that *primary* sensors are needed to detect primary phenomena, not just secondary shadows thereof. However, looking at our present topic, we electronics people need not all be psychical researchers, nor start looking for new Bridey Murphys. Suffice it to realize that the life of *any* biological organism implies a coordination, a creative agency, a purposiveness, a history, a power of trading with time — in all of which mere physics are transcended. ❐

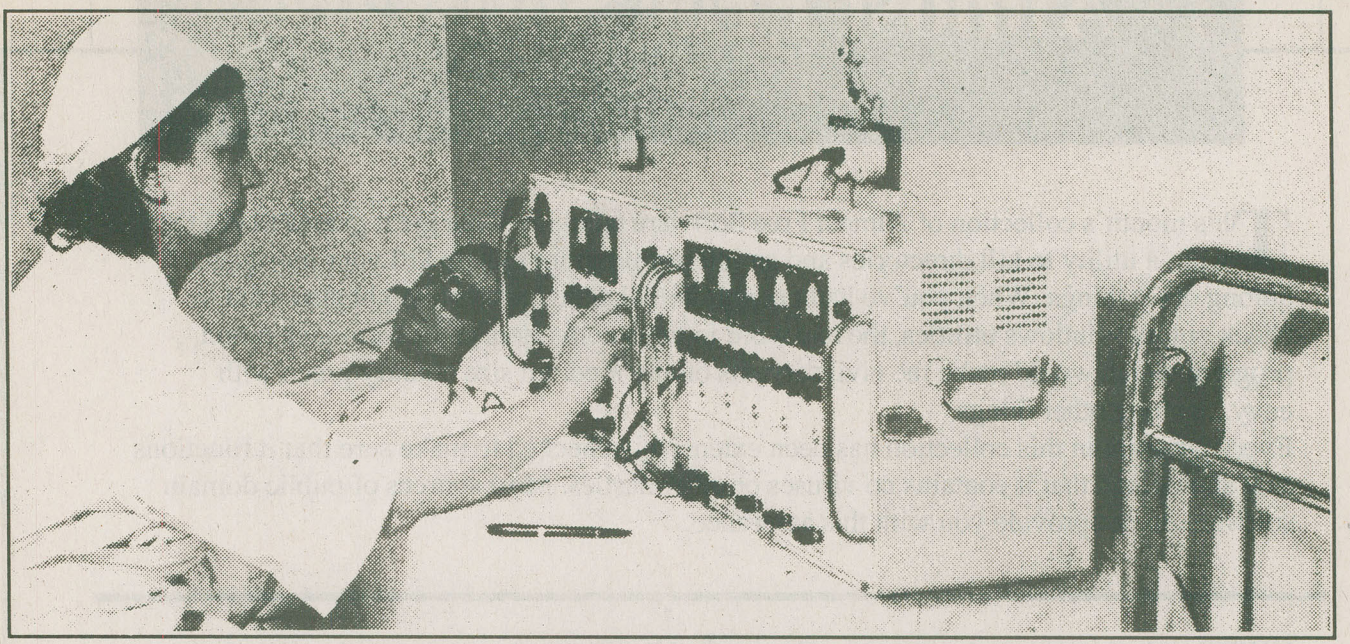

Fig. 11. A Russian electrosleep arrangement with equipment and nurse. Low-frequency currents are applied by electroded eye masks. Forbearer of occult dream-sleep electronics. See text.

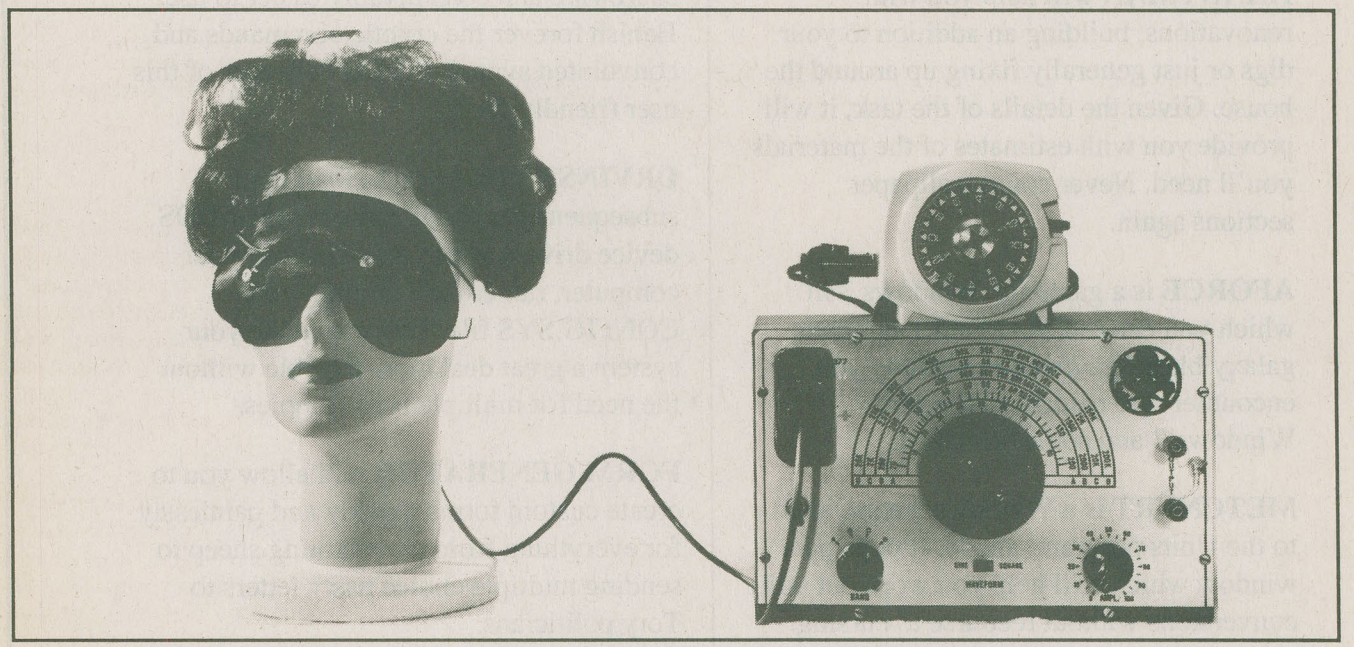

Fig. 12. Occult dream-sleep electronics. Based on application of audio-frequency harmonics combined with receiver's psychological constellations. Mannequin-type icon, left, provides dream target symbol in Yeats' tradition.

Almost Free Software

Volume 70

This month's collection of Almost Free Software contains some great games to kill time with, a utility to kill directories and an interest program to help kill your mortgage, among other things. When you've had enough virtual slaughter, you might also want to check out its Windows utilities, the last word in units converters and a form generation program which would make the civil servants of any medium size country green with envy... among other things.
Every program in this collection has been extensively checked to make sure that it functions as it should and that it contains no viruses or other nasties. Most sources of public domain software do not provide you with this assurance.

UNITS is the most complete program for converting between different units of measurement. It's not every day you'll want to know how many furlongs are in a light year, but should you ever have need to, this will work out the calculations.

HANDYMAN will help you with renovations, building an addition to your digs or just generally fixing up around the house. Given the details of the task, it will provide you with estimates of the materials you'll need. Never count wallpaper sections again.

AFORCE is a game for Windows 3 in which you can cruise around a synthetic galaxy blasting *almost* everything you encounter into neutrinos. Requires Windows 3 and some bloodlust.

METCNVRT is a Windows 3 equivalent to the Units program, above. It pops up a window which will help you work out unit conversions without recourse to cursing.

INTEREST calculates every imaginable permutation of loans, mortgages, annuities and other situations into which interest might enter.

VI will help keep your collection of Windows 3 icons in order. It lets you look at them *before* you associate them with applications. Requires Windows 3.

DOS COMMANDER is very much like Norton Commander, except that it's shareware and considerably easier to use. Banish forever the cryptic commands and convoluted syntax of DOS in favour of this user friendly shell.

DRVINST allows you to load (and subsequently unload) some types of DOS device drivers after you've booted your computer, rather than through your CONFIG.SYS file. This can make your system a great deal more flexible without the need for multiple boot floppies.

FORM GENERATOR will allow you to create custom forms quickly and painlessly for everything from enumerating sheep to sending multiple choice nasty letters to Tory politicians.

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PLEASE NOTE THAT SOME OF THE FILES ON THESE DISKS ARE NUDES, AND MAY NOT BE SUITABLE FOR YOUNG OR SENSITIVE USERS.

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Ships of the desert... the kind you ride, rather than the ones that give you cancer.

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A natural blond, mayhaps.

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Girl in the wilderness.

JAPAN
Or rather, one citizen of it.

WINEPOUR
Wine being poured, although there are no wine glasses in sight.

OCEAN
A ray traced sea, surrealistic surf and a dock from Mars.

RENEE
Looking thoughtful.

INDY
Doctor Jones, one time raider of the lost ark.

POLITESS
One girl, one leather jacket, one Browning pistol.

WATERBOWL
Another bit of ray tracing.

BATHING
Or rather, just after bathing.

MARY
The difference between pink and magenta is a fine line.

DICE
Laughing bones, ivory cubes, ray traced solids.

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Considers her limited wardrobe.

SNEAKERS
Appear to be Reeboks with their markings airbrushed out.

ENGINE
A twenty-four valve Ford engine.

ROOM
Another bit of CAD... a computer generated room with computer generated furniture and a computer generated mortgage.

KIKI
A frame of Japanimation captured for all eternity.

JAMAICA
Not nearly as good as being there.

JESSICA
Ms. Rabbit in a scene not shown in the movie.

WAVES
The roar of the surf, the cry of the gulls...

LOWTIDE
White sand and a suntan.

BEACHGIRL
Perhaps not surprising, a girl on the beach.

SYBIL
Having recently put down the book she was studying.

SUSAN
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World Travel Without Leaving Home

What's Amateur (Ham) Radio?

by Bob Havens, VE3IYO (VE3MPS)

The Department of Communications (D.O.C.) for Canada has set aside portions of the radio band for two way communication for its citizens. Like your household radio there is AM and FM transmission along with other frequencies and formats. You can operate G.R.S. (General Radio Service) better known as C.B. (Citizen Band) with no license requirements. Just go to your local electronics store and purchase a pair of radios and you are in business. C.B. is making a comeback of sorts now that it has been deregulated but I doubt it'll ever be as popular as it was in the late 70s! Fishermen, boaters and sailors alike are now equipping their crafts with marine radio for safety and weather information. Private business has a part in all this and the list goes on... however, your query is with the amateur portion of the band. The government has allocated a generous bandwidth for our hobby. Since it would be impossible to cover it all in one article I thought a general introduction would be best.

- What's Amateur Radio Made Of?
- Calls round the world; phone patches from cars.
- Signals that go straight; others go far.
- Computer linked terminals at no charge to you;
- Bands that are clear and some like the zoo!
- Friends at the meetings, field days or ham fests-
- These are some things that I like the best.
- Round table night networks with club personnel;
- How you can get started — I'm just going to tell!

My Story — How I Started

On February 14th, 1976 we were moving to our new home just north of London, Ontario where we had lived for the first 5 years of our marriage. I was working in Mitchell and we had a home in a small village 10 km south of the town. We wanted to keep in touch so we purchased a pair of CB radios and they did the trick for us. We met a great number of outgoing people and were fascinated by the hobby. One evening about 2 AM when I was about to make a pit stop I noticed the radio had not been disconnected and before doing so I thought I would listen to see if anyone would possibly be on the air. It was the weekend and I might contact a late night traveller or two. What followed was the groundwork for me becoming a ham operator. The signals that evening were bouncing all over Canada and the United States. What was normally a 20 mile radius for radio contacts had been transformed to thousands. I spoke with over 15 different CB operators in the mid western United States and by 4 o'clock the conditions had changed and I went back to bed. I knew that what I had done was a fluke as well as illegal. I found out that I could probably do this more often if I was willing to do one of two things.

1. Build a little better antenna system. Run illegal power and continue to hope for illegal contacts.
2. Study, write an exam and become an Amateur Radio Operator and extend my contacts world wide legally.

see **Ham**, *page 35*

Babani Book of the Month

Welcome to our feature, the Babani Book of the Month. In each issue we will present an excerpt from a particular Babani Book. This month we are featuring *Popular electronic Circuits Book 2* by R. A. Penfold, book number BP98. To order this, or any Babani book, fill out the order form at the end of this article and send it in with the appropriate payment.

Popular Electronic Circuits Book 2 is just loaded with interesting and useful circuits and projects! The main categories include, Audio Circuits, Test Gear Circuits, Radio Circuits, Home and Car Circuits and Miscellaneous Circuits. Some of the more interesting circuits are, an R.I.A.A. Preamplifier, a Signal Injector, a Signal Tracer, a Zener Diode Tester, a Short Wave Converter, a Drum Synthesizer, Quiz Monitor and many more.

Capacitance Meter

This capacitance meter has four measuring ranges of 1 nf, 10 nf, 100 nf, and 1 µF f.s.d. (full scale deflection), and the scaling is linear on all four ranges. The circuit diagram of the unit is shown in Fig. 1 and this uses a conventional arrangement with an astable multivibrator driving a monostable type. The astable is based on IC1 which is a standard 555 type oscillator. The monostable uses IC2 in the standard 555 monostable configuration. R8 and D1 form a simple zener shunt stabiliser circuit, and these give stabilised 5.6 volt pulses from IC2. R9 and ME1 form a simple voltmeter circuit, and this responds to the average output voltage of IC2.

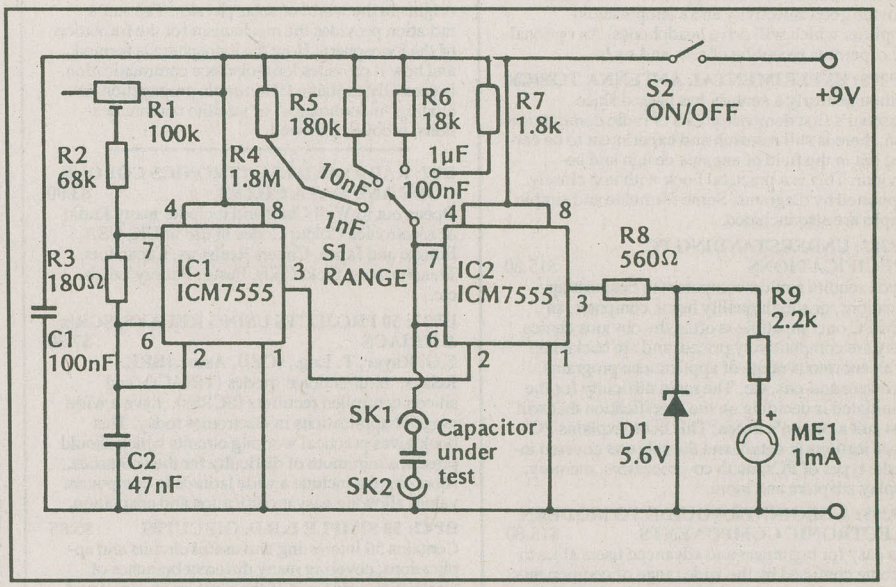

Fig. 1 The Circuit Diagram of the Capacitance Meter

The frequency of the output pulses from IC2 depends upon the frequency at which IC1 oscillates, since the output of IC1 consists of a series of short negative pulses which are used to trigger IC2. The length of the output pulses depends on the value of the capacitor under test (which is used as the timing capacitor for IC2), and the timing resistance value selected using S1. The length of the output pulses is proportional to the value of both timing components.

In practice R1 is adjusted so that with a capacitor of 1nf in value connected across the test terminals, and S1 set to the 1nf position, the circuit gives full scale deflection of ME1. A lower value of test capacitance gives a shorter output pulse length, and a proportionate reduction in the average output voltage (and reading on ME1). The required

Continued

Babani Books

New Releases

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This book describes over 60 modular electronic circuits — how they work, how to build them, and how to use them. The modules may be wired together to make hundreds of different electronic systems, both analogue and digital. To show the reader how to begin building systems from modules, a selection of over 25 electronic systems are described in detail, covering such widely differing applications as timing, home security, measurement, audio, games and remote control.

BP276: SHORT WAVE SUPERHET RECEIVER CONSTRUCTION $11.80
The basic short wave receiver described in this book is a superhet type having separate mixer and oscillator stages, two i.f. stages, a ceramic filter to provide good selectivity and a simple audio amplifier which will drive headphones. An optional b.f.o. permits reception of c.w. and s.s.b.

BP278: EXPERIMENTAL ANTENNA TOPICS
Although nearly a century has passed since Marconi's first demonstrations of radio communication, there is still research and experiment to be carried out in the field of antenna design and behaviour. This is a practical book with text closely supported by diagrams. Some formulae and simple graphs are also included.

BP282: UNDERSTANDING PC SPECIFICATIONS $15.80
If you require a microcomputer for business applications, or a high quality home computer, an IBM PC or compatible is often the obvious choice. They are competitively priced, and are backed up by an enormous range of applications programs, hardware add-ons, etc. The main difficulty for the uninitiated is deciding on the specification that will best suit a person's needs. This book explains PC specifications in detail, and the subjects covered include: types of PCs, math co-processors, memory, display adaptors and more.

BP285: A BEGINNERS GUIDE TO MODERN ELECTRONIC COMPONENTS $15.80
It is easy for beginners and advanced users alike to become confused by the wide range of components currently available. In this book, the basic functions of the components are described. The main thrust of the book is concerned with practical aspects such as colour codes, deciphering code numbers and the suitability of components for given applications. Essential reading for all electronic enthusiasts, this book presents a vast amount of invaluable information to enable you to select the right components every time.

BP290: AN INTRODUCTION TO AMATEUR COMMUNICATION SATELLITES $15.80
Communications and broadcast satellites are normally inaccessible to individuals. There are a large number of amateur communications satellites in orbit around the world, and they can be tracked and their signals received with relatively inexpensive equipment. This equipment can be connected to a home computer such as the IBM compatible, for the decoding of received signals. This book describes several currently available systems, their connection to an appropriate computer and how they can be operated with suitable software.

BP292: PUBLIC ADDRESS LOUDSPEAKER SYSTEMS $15.80
The loudspeaker system is a critical part of any public address installation. All too often it is woefully inadequate, resulting in poor intelligibility and unnatural reproduction. We here examine the various systems and their drawbacks, and describe LISCA, the Line-Source Ceiling Array. This gives astonishing clarity, even coverage, reducing feedback, natural source location and even a pseudo-stereo effect. It promises to be the ultimate system for small to medium sized halls. Full step-by-step construction and installation details are given.

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Radio wave propagation, one of the more important discoveries made in the early 20th century, has its origins in the world of solar physics. The sun's radiation provides the mechanism for the formation of the ionosphere. How the ionosphere is formed, and how it provides long-distance communication, is carefully explained. Non-ionic propagation, including "moonbounce" or satellite communications, is covered as well.

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This book contains all the fundamental theory necessary to lead to a full understanding of the simple electronic circuit and its main components.

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This book continues with alternating current theory without which there can be no comprehension of speech, music, radio, television or even the electricity utilities.

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Follows on semiconductor technology, leading up to transistors and integrated circuits.

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A book covering the whole communication scene.

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The aim of this book is to enable the reader to simply and inexpensively construct and examine a number of basic computer circuit elements and gain a fuller understanding of how the computer chip works.

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F.G. Rayer, T. Eng. (CEI), Assoc.IERE.
This book contains both simple and more advanced projects for the reader developing a knowledge of the workings of digital circuits. To help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams.

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R.A. Penfold
Although one of the more recent branches of amateur electronics, electronic music has now become extremely popular. The purpose of this book is to provide the constructor with a number of prac-

tical circuits for the less complex items of electronic music equipment, including such things as a Fuzz Box, Waa-Waa Pedal, Sustain Unit, Reverberation and Phaser Units, Tremolo Generator, etc.

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BP92: ELECTRONICS SIMPLIFIED - CRYSTAL SET CONSTRUCTION $5.25
This is a book written especially for those who wish to participate in the intricacies of electronics.

BP94: ELECTRONIC PROJECTS FOR CARS AND BOATS $7.80
R.A. Penfold
Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarms.

BP95: MODEL RAILWAY PROJECTS $7.80
Electronic projects for model railways are fairly recent and have made possible an amazing degree of realism. The projects covered included controllers, signals and sound effects: stripboard layouts are provided for each project.

BP98: POPULAR ELECTRONIC CIRCUITS, BOOK 2 $9.00
R.A. Penfold
70 plus circuits based on modern components.

BP101: HOW TO IDENTIFY UNMARKED IC's $1.95
An unusual and fascinating chart that is highly recommended to all those interested in electronics and which will hopefully pay for itself many times over, by enabling the reader to use IC's that might otherwise have been scrapped.

BP103: MULTI-CIRCUIT BOARD PROJECTS by R.A. Penfold $7.80
This book allows the reader to build 21 fairly simple electronic projects, all of which may be constructed on the same printed circuit board. Wherever possible, the same components have been used in each design so that with a relatively small number of components and hence low cost, it is possible to make any one of the projects or by re-using the components and P.C.B. all of the projects.

BP106: MODERN OP-AMP PROJECTS by R. A. Penfold $7.80
Features a wide range of constructional projects which make use of op-amps including low-noise, low distortion, ultra- high input impedance, high slew-rate and high output current types.

BP110: HOW TO GET YOUR ELECTRONIC PROJECTS WORKING $7.80
R.A. Penfold
We have all built circuits from magazines and books only to find that they did not work correctly, or at all, when first switched on. This book will help the reader overcome these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

BP111: AUDIO $14.00
Covers a wide range of material from analysis of the sound wave, mechanism of hearing, acoustics, microphones and loudspeakers, amplifiers, and magnetic disc recording.

BP115: THE PRE-COMPUTER BOOK $5.85
Aimed at the absolute beginner with no knowledge of computing, this entirely non-technical discussion of computer bits and pieces and programming is written mainly for those who do not possess a microcomputer but intend to one day own one.

BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS – BOOK 2 $7.60
R.A. Penfold
This sequel to **BP117 is written to help the reader create and experiment with his own circuits by combining standard type circuit building blocks. Circuits concerned with generating signals were covered in Book 1, this one deals with processing signals.**

BP121: HOW TO DESIGN AND MAKE YOUR OWN PCBs $5.85
The purpose of this book is to familiarize the reader with both simple and more sophisticated methods of producing printed circuit boards. The book emphasizes the practical aspects of printed circuit board designs and construction.

BP122: AUDIO AMPLIFIER CONSTRUCTION $6.75
A wide circuits is given, from low noise microphone and tape head preamps to a 100W MOSFET type. There is also the circuit for 12V bridge amp giving 18W. Circuit board or stripboard layout are included. Most of the circuits are well within the capabilities of even those with limited experience.

BP125: 25 SIMPLE AMATEUR BAND AERIALS $5.85
This book describes how to build 25 amateur band aerials. The designs start with the simple dipole and proceed to beam, triangle and even a mini-rhombic.

BP127: HOW TO DESIGN ELECTRONIC PROJECTS $9.00
Although information on stand circuits blocks is available, there is less information on combining these circuit parts together. Practical examples are used and each is analyzed to show what each does and how to apply this to other designs.

BP130: MICRO INTERFACING CIRCUITS BOOK 1 $9.00
Aimed at those who have some previous knowledge of electronics, but not necessarily an extensive one, the basis of the book is to help the individual understand the principles of interfacing circuits to microprocessor equipment.

BP131: MICRO INTERFACING CIRCUITS – BOOK 2 $9.00
Intended to carry on from Book 1, this book deals with practical applications beyond the parallel and serial interface. Real world interfacing such as sound and speech generators, temperature, optical sensors, and motor controls are discussed using practical circuit descriptions.

BP136: SIMPLE INDOOR AND WINDOW AERIALS $7.00
People living in apartments who would like to improve shortwave listening can benefit from this book on optimizing the indoor aerial.

BP155: INTERNATIONAL RADIO STATIONS GUIDE $9.00
An invaluable aid in helping all those who have a radio receiver to obtain the maximum entertainment value and enjoyment from their sets.

BP174: MORE ADVANCED ELECTRONIC MUSIC PROJECTS $12.00
Complementing Book PB74, Electronic Music Projects,

BP174 provides projects, such as a flanger, a phaser, mini-chorus and ring modulators, percussion synths, etc. Each project has an Introduction circuit diagram and constructional notes.

BP179: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS $12.00
The main stumbling block for most would-be robot builders is the electronics to interface the computer to the motors, and the sensors which provide feedback from the robot to the computer. The purpose of this book is to explain and provide some relatively simple electronic circuits which bridge the gap.

BP180: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS $9.00
Shows how home computers can easily be applied to the control of model railroads and other quite sophisticated control. A variety of projects are discussed as well as circuits for train position sensing, signal and electric points control, etc.

BP185: ELECTRONIC SYNTHESIZER CONSTRUCTION $9.00
With this book a relative beginner should be able to build, with a minimum of difficulty and at a reasonably low cost, a worthwhile monophonic synthesizer and also learn a great deal about electronic music synthesis in the process.

BP192: MORE ADVANCED POWER SUPPLY PROJECTS $8.00
Robert Penfold.
A companion to BP76, this book covers switched mode supplies, precision regulators, tracking regulators, computer- controlled supplies, etc.

BP225: A PRACTICAL INTRODUCTION TO DIGITAL ICs $7.00
This book deals mainly with TTL type chips such as the 7400 series. Simple projects and a complete practical construction of a Logic Test Circuit Set are included as well as details for a more complicated Digital Counter Timer project.

BP233: ELECTRONIC HOBBYIST HANDBOOK $15.00
A single source of easily located information: colour codes, pinouts, basic circuits, symbols, etc.

BP239: GETTING THE MOST FROM YOUR MULTIMETER $9.00
This book is aimed at beginners in electronics. Using the simple component and circuit testing techniques in this book the reader should be able to confidently tackle servicing of most electronic projects.

BP240: REMOTE CONTROL HANDBOOK $12.00
Includes remote control systems, transmission links, digital electronics, methods of control, decoders, etc.

BP245: DIGITAL AUDIO PROJECTS $11.80
This book takes a look at the basic principles involved in converting an audio signal into digital form and then converting it back to an analogue signal again. It also contains practical circuits for constructors to build and experiment with.

BP247: MORE ADVANCED MIDI PROJECTS $11.80
This book includes circuits for a MIDI indicator, THRU box, merge unit, code generator, pedal, programmer, channeliser and analyzer.

BP248: TEST EQUIPMENT CONSTRUCTION $11.80
This book describes in detail how to construct some simple and inexpensive, but extremely useful, pieces of test equipment.

BP249: MORE ADVANCED TEST EQUIPMENT CONSTRUCTION $14.00
This book carries on from BP 248, TEST EQUIPMENT CONSTRUCTION, describing some slightly more advanced projects for readers who have a certain amount of experience at project construction.

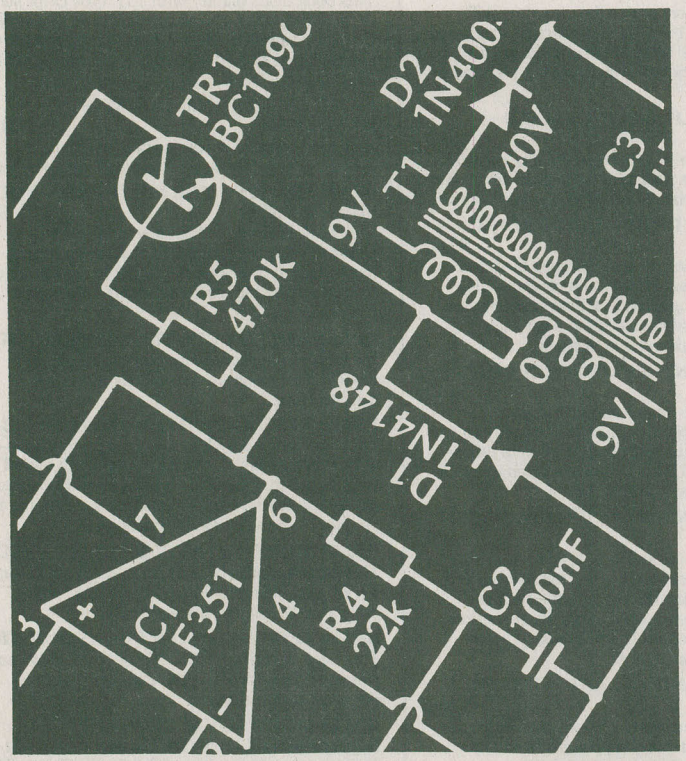
BP251: COMPUTER HOBBYISTS HANDBOOK $23.80
This book provides a range of useful reference material in a single source so that it can be quickly and easily located. The subjects covered include microprocessors and their register sets; interfacing serial, parallel, monitor, games and Midi ports; numbering systems; Midi codes; operating systems and computer graphics.

BP256: AN INTRODUCTION TO LOUDSPEAKERS AND ENCLOSURE DESIGN $11.80
This book explores many types of enclosures and drive units. Crossover units are also explained, the various types, how they work, the distortions they produce and how to avoid them.

BP257: AN INTRODUCTION TO AMATEUR RADIO $14.00
Topics covered in this book include the basic aspects of the hobby, such as operating procedures, jargon and setting up a station. Technical topics include propagation, receivers, transmitters and aerials etc.

Popular Electronic Circuits Book 2

R.A. PENFOLD



linear scale capacitance meter action is thus obtained. Switching S1 to the 10nf, 100nf, and 1µF ranges causes the timing resistance to be reduced by a factor of ten at each new setting, so that the test capacitance needs to be ten times greater in order to produce a given meter reading. This gives four measuring ranges, but R4 to R7 must be close tolerance (2% or better) types in order to give consistent accuracy on all ranges

CMOS 555 devices are used (Radio Shack catalog #276-1718) in the circuit as these have a much lower supply current drain, and a lower self capacitance so that slightly better accuracy is obtained when measuring low value components.

The layout of the components is not critical, but you should obviously arrange the circuit to give a low level of stray capacitance across the test sockets. The circuit can be calibrated on any range using a capacitor having a close tolerance and a value equal to the f.s.d. value for that range. With the test capacitor connected into the circuit, R1 is adjusted for precisely full scale deflection (but make sure that the meter is properly zeroed mechanically before calibrating the unit). The unit is then ready for use. ❐

Ham, *Cont'd from page 30*

That was some 15 years ago now and as you might have guessed I chose option number two. My contacts have expanded world wide but I also keep and enjoy local radio conversations with a network of hams from my immediate area. Both are enjoyable and rewarding to me.

It's Not All Talk:

My reasons and enjoyment may be quite different from your own so don't start to think this hobby is only for the oral and vocal part of our population. If you have a computer now and would like to explore telecommunications in a way that is exciting, challenging and economical. Amateur radio is your ticket. Your license is often referred to as your 'ticket' for the very reason it can take you on so many different rides in the amusement park of life. If you are involved in tinkering with capacitors, coils and resistors or just bending wire in the right shape and length for a better antenna, this hobby welcomes and encourages your involvement.

Don't think it is too much yak and not enough hack. I had the entirely opposite opinion and was even told by one misinformed individual that I would have to build my own receiver as part of my examination to become an amateur operator. It is lucky for me I talked to Harry (a licensed ham and CB enthusiast) to get the straight dope. Chat with people involved in the hobby to get your questions answered.

How Has It Changed?

As I mentioned earlier, I studied and wrote an exam. I enroled in a course offered down the road in Stratford. There were 15 of us studying together. We met once a week and covered theory, regulations, operation and code. The code is what deterred most of the students from even trying the exam. It all seemed like an enormous job that would never end.

Good news for those who have already decided from reading this article or other reasons you are willing to give it a try — the code has been separated from the technical theory and regulations. There are no essay examination questions. All questions are multiple choice. As of last October the first step down the road to international radio communications is easier than it has ever been.

I'm Convinced — How Do I Start?

Here are some sure fired steps to success and your very own Amateur Radio Operator's Certificate and Station License!

1. Join a local Amateur Radio Club. We have three such clubs in our Stratford area and although they are formed for many different purposes two of these clubs offer classes for those studying to get their license.

2. Enrol yourself in a course if you are NOT the home study type. However, home study has been made reasonably simple with the latest CARF (Canadian Amateur Radio Federation) study manual. Our latest new ham in the Stratford area obtained his ticket in December by reading and studying this book on his own!

3. Buy the CARF manual whether you are involved in a group course or home study:

   Canadian Amateur Radio Federation Inc.
   P.O. Box 356
   KINGSTON; Ontario; Canada
   K7L 4W2
   1-613-545-9100

There is a great deal to give and receive from the hobby that it really does fit the old cliche 'It grows as you grow'! My main purpose for this article was to spur your interest. Next time I will explain the privileges of amateur communication in more detail and some home study tips. Hopefully I can follow this with some advice on establishing your first station at home and advice on equipment, antennas and protocol. Hope to hear you on the air before another year is gone. My only regret is that I didn't begin this sooner. My joy is in the fact that as I age even with frightening possibilities of blindness or crippling arthritis I can stay at my hobby and on the air. I have had conversations with hams in nursing homes and hospitals as well as those convalescing at home. It is truly a marriage that lasts through sickness and health — one worthy of your pursuit! ❐

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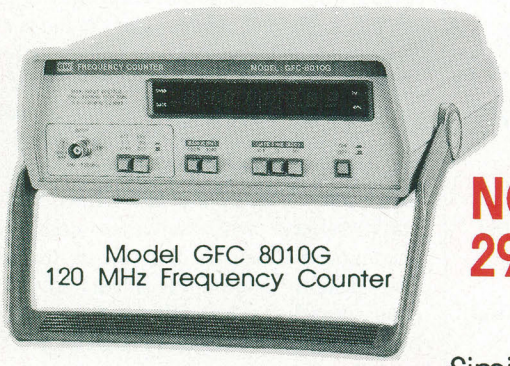

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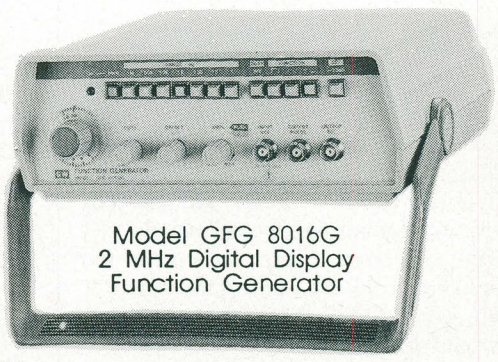

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